Requires obtaining project(s) milestones and schedule status

2.7.7: Avionics and Software
Requires obtaining project(s) milestones and schedule status

2.8: Subtask 8 -- Small Projects Office
2.8.1: Deliverables: R1Supply Office Head with a copy of all the Small Projects Office Project Master ***Schedules***

Detailed schedules will be developed and managed for the following Small Projects Office:
End R2 block update

2.8.2: MEDLI (Mars Entry, Descent, and Landing Instrumentation)
2.8.2.1: Deliverables: R1Updated Integrated Master Schedule (IMS) (monthly), Langley Center Management Council (CMC) schedule charts (monthly), and Master Schedule for various reviews and presentations (as required).

R1>**2.8.3: HSA**
2.8.3.1: Deliverables: Updated weekly schedule package (due to the fast pace of this project), Langley Center Management Council (CMC) schedule charts (monthly), and Master Schedule for various reviews and presentations (as required).<R1

R1**2.8.4: Hy-BoLT**
2.8.4.1: R1Deliverables: Lower level/supporting schedules and an integrated master schedule (IMS) shall be developed for the project office to include the integration of NASA and Contractor schedules. Lower level/supporting schedules shall be analyzed and assessed on a monthly basis and as programmatic changes occur. Monthly status, forecasts, and schedule analysis shall be provided in a Monthly Management Report (MMR). In addition to the MMR, other deliverables shall include: R1Center Management Center (CMC) reports.

Begin R2 block addition
2.8.5: PAI DAE
2.8.5.1: **Deliverables:** Updated Integrated Master Schedule (IMS) (monthly), Langley Center Management Council (CMC) schedule charts (as required), MMR (monthly, pending IMS baseline), and Master Schedule for various reviews and presentations (as required).

2.8.6: IRVE II
2.8.5.1: **Deliverables:** Updated Integrated Master Schedule (IMS) (monthly), Langley Center Management Council (CMC) schedule charts (as required), MMR (monthly, pending IMS baseline), and Master Schedule for various reviews and presentations (as required).
End R2 block addition

2.9: Subtask 9 -- Space Operations Program Office: An integrated master schedule will be developed and managed for Space Operations Projects
2.9.1: Deliverables: Space Operations Program Office Integrated Master Schedule Gantt Chart

2.10: Subtask 10 -- Launch Abort System (LAS): Project planning and schedule management shall be provided to the Launch Abort System

2.10.1: Deliverables: R2>Supporting schedules come from the contractor and subcontractors.<R2 A master schedule (IMS) shall be developed for the project office to include the integration of NASA and Contractor schedules. Lower level/supporting schedules shall be analyzed and assessed on a monthly basis and as programmatic changes occur. Monthly status, forecasts, earned value assessment and schedule analysis shall be provided in a Monthly Management Report (MMR). In addition to the MMR, other deliverables shall include: R1a monthly Technical Cost Schedule Report (TCSR); and Center Management Center (CMC) reports.

Begin R2 block addition

2.11: Subtask 11 – Science Mission Projects

2.11.1 - Clouds and the Earth's Radiant Energy System (CERES): Project planning and schedule management shall be provided to the CERES Project

2.11.1.1: CERES Flight Model 5

2.11.1.2: Deliverables: Lower level/supporting schedules (including algorithm and software development) and an integrated master schedule (IMS) shall be developed for the project office to include the integration of NASA, National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP), and Contractor schedules. Lower level/supporting schedules shall be analyzed and assessed on a bi-weekly basis until instrument delivery scheduled in October 2008 and as programmatic changes occur. Monthly status, forecasts, earned value assessment, and schedule analysis shall be provided in a Monthly Management Report (MMR). Provide biweekly review of contract schedule progress and provide verbal assessment to project management. Provide Center Management Council (CMC) schedule charts (monthly) and schedule/milestone charts for management reviews at LaRC and Goddard Space Flight Center (GSFC). Provide and update schedule logic flow/network diagrams for contractor and LaRC algorithm and software development (monthly).

2.11.2 - Climate Absolute Radiance and Refractivity Observatory (CLARREO): Project planning and schedule management shall be provided to the CLARREO Project

2.11.2.1: Deliverables: Lower level/supporting schedules (including algorithm and software development) and an integrated master schedule (IMS) shall be developed for the project office to include the integration of NASA and Contractor schedules. Lower level/supporting schedules shall be analyzed and assessed on a monthly basis and as programmatic changes occur. Monthly status, forecasts, earned value assessment, and schedule analysis shall be provided in a Monthly Management Report (MMR). Provide biweekly review of contract schedule progress and provide verbal assessment to project management. Provide Center Management Council (CMC) schedule charts (monthly) and schedule/milestone charts for management reviews at LaRC, for Earth Systematic Missions Program Office, and at NASA Headquarters (HQ). Provide and update schedule logic flow/network diagrams for contractor and LaRC algorithm and software development (monthly).

End R2 block addition

2.n Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized R2>support the requirements of this task order.<R2

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management

walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

4. Other Essential Information:

(1) Travel will be required for each of the subtasks listed above. Each organization, program or project will provide funds to cover travel costs.

(2) 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 this contract.

(3) Special training may be required from time to time. The Technical Monitor will review the training requirements and coordinate the requirements with the Contractor with the appropriate rationale.

(4) Attendance at conferences may be required from time to time. The Technical Monitor will review the conference agenda and coordinate the requirements with the Contractor with the appropriate rationale.

(5) Due to the schedule critical nature of project work, the Contractor may need to work beyond the normal work schedule with reasonable compensatory allowances to maintain personal safety and health.

5. Security Clearance: As defined at the subtask level.

6. Period of Performance:

Planned start date: R1January 25, 2007 Completion date: R1~~December 31, 2007~~ R3~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Primary Technical Monitor (Required): R2**Yvonne Dellapenta**

M/S: 494 Phone: (757) 864-2760

Alternate Technical Monitor: **Kathryn Ferrare**

M/S: 494 Phone: (757) 864-3776

TASK ORDER NUMBER: 046D3-NNL07AM73T Revision: 2 Change: 0 Date: February 07, 2008

Title: Independent Technical Review and Editing Support

1. Purpose, Objective, or Background (Optional)

The NASA Governance Model identifies the requirement to perform Independent Technical Reviews (ITR) to ensure technical excellence and mission success for NASA programs and projects. The purpose of the ITRs is to bring the Country's outstanding technical experts together to review program/project plans, milestones, deliverables, and risks, and provide an assessment and raise issues and concerns regarding mission success.

Once Langley Research Center has identified the need for an ITR, a team is formed to establish the approach and then conduct the assessment. Each team may include experts from across NASA and may include experts and consultants from other government organizations, national laboratories, universities and industry. Each assessment is different and the duration can range from a few days up to 6 months.

The purpose of this task order is to provide experts to participate in the ITRs. Additionally, as a follow-on to SAMS task order 08D3, the Contractor will be expected to provide technical editing, review, and documentation support for various publication requirements such as conference papers, NASA reports, and Center presentations.

*****Begin [R2] block addition*****

In the editing, review, and documentation support the Contractor will be expected to respond rapidly to multiple users with a variety of specific requirements that are short duration and low budget. These requirements will be difficult to manage as well as a challenge to achieve publication technical excellence in the face of a civil servant workforce that is often stretched to the limit in its labor resources. The Contractor's ability in effective communication, staffing, and response can be quite an asset to the publication goals of NASA's mission and programs. In some cases it is anticipated that the Contractor will need to seek Technical Direction from the Contracting Officer's Technical Representative (COTR) to prioritize NOCs based on available funding and finished product schedule.

*****End [R2] block addition*****

Revision 1 (9/18/07): Extends the period of performance 6 months to June 30, 2008 in continuation of NASA's support, updates the initial task order start date to April 12, 2007, and clarifies safety and organization Subtask 2.n (see [R1] below).

Revision 2 (2/7/08): Extends the period of performance 12 months to June 30, 2009 in continuation of NASA's support requirements with some clarifying comments in Section 1, above (see [R2] above and below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** to this task order. As each specific support requirement becomes defined, the Technical Monitor or other users will provide clarification to the Contractor. See NOC designated item(s) and description below. In some instances the Contractor shall provide a rough order of magnitude (ROM) cost estimate before performing the requirements and again at completion of the requirement. NASA will use these ROMs in deciding whether to require the support in actual instances and in managing the cost-sharing among support users.

2.1 (NOC) Technical Expertise. The Contractor shall provide appropriate technical experts to participate in and significantly contribute to the findings and operations Independent Review Teams. The Contractor shall perform technical analyses and/or recommendations in relevant engineering or scientific disciplines, including but not limited to: Guidance, Navigation and Control; Non-Destructive Evaluation; Propulsion;

Power and Avionics; Mechanical Analysis; Flight Sciences; Mechanical Systems; Human Factors; Materials; Structures; Fluids/Life Support/Thermal; Software; Manned Flight Operations; Robotic Missions; and Systems Engineering.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required): Each Contractor-provided technical expert shall contribute to written products such as test plans, reports, analysis results, summaries, recommendations, and findings documented in NOCs, and approved by the assessment team leader or Technical Monitor. The Contractor shall deliver a brief monthly report outlining assessment and activities supported and contributions made. All written products are to be delivered as established by NOC.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting"):

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.

2.2 (NOC) Technical Editing: The Contractor shall edit, review, recommend changes to, and prepare draft publications containing advanced technical subject matter related to NASA's mission according to provided templates and content. The Contractor shall ensure required documents are written for clarity, grammar, punctuation, spelling, capitalization, diction, and format in accordance with approved publication standards appropriate to the publication media. The Contractor shall report monthly actual and projected costs in compliance with normal contract requirements.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required): The Contractor shall provide the results from 2.2 above according to the schedule, format, and media that are mutually agreed upon during NASA's requirement clarification.

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: The Contractor will warrant a "meets" rating if results are delivered complete according to the clarified and mutually established specifications.

Exceeds: The Contractor will warrant an "exceeds" rating if "Meets" applies and either a) or b) below occurs:

a) Results are delivered ahead of schedule

b) Results include significant improvements to the publication beyond what is normally expected in the editing process.

2.n Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and

organized to [R1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

a) Templates and content for required documentation.

b) Required office space, telephone, and IT access.

4. Other Essential Information:

- It is anticipated that initially about 5 ITRs with 2 technical experts per review and about 20% of a work year equivalent (WYE) editing support will be needed, but the actual level will depend on the complexity and nature of the individual ITR and publication requirements and the interest in this service within the technical community at LaRC. [R1]For planning purposes, it is anticipated that the current rate of usage will continue through [R2]~~June 30, 2008~~ ***June 30, 2009***.
- The actual timing of the support may vary in the publication edit/review cycle and may require the Contractor's attendance at some editorial committee meetings. These specific requirements will be established on a case by case basis.

5. Security Clearance: Contract procedure for release of technical data and normal Center IT practices apply, but non-disclosure agreements and/or other security may be needed in some instances.

6. Period of Performance:

Planned start date: [R1]April 12, 2007 Completion date: [R1]~~December 31, 2007~~ [R2]~~June 30, 2008~~ ***June 30, 2009***

7. NASA Task Management:

Technical Monitor (Required): L. David Wall, Jr.

M/S: 162 Phone: 757-864-2944

Other POC (Optional):

M/S: Phone:

1. Purpose, Objective, or Background (Optional) (Ref: SAMS Task Order Number(s) 05RCC and 06RCD)

While providing support to the Durability, Damage Tolerance and Reliability Branch (DDTRB), the overall objective of this task is to support the advancement of the state of the art in the areas of computational, analytical and experimental research in basic structural behavior and testing of aerospace models and to develop efficient, physics-based analytical and computational methods to enable multidisciplinary design and analysis of advanced materials and structures for aerospace applications.

The Contractor will be expected to perform the following general requirements as applicable to specific subtasks:

- Conduct research and technology development of analytical, computational, and experimental methods to quantify behavior, durability, and damage tolerance and to validate performance of advanced materials and structures for aerospace applications in support of Langley programs.
- Conduct structural analyses and design studies, [R1]~~CAD design,~~ analysis of test specimens, and support for testing of advanced metallic and composite materials and structures representative of airframe, spacecraft, and space transportation systems in support of Langley programs.
- Conduct material characterization, fatigue and fracture testing of advance materials and structural systems in support of Langley programs.

Revision 1 (6/20/07): Extends the overall period of performance and the subtask 2.5 schedule one year in continuation of NASA's support requirements, updates the initial task order start date to January 25, 2007, re-designates safety and organization subtask as 2.n (see [R1] below).
Revision 2 (11/15/07): clarifies safety and organization Subtask 2.n and updates schedule and other details of active work through December 31, 2008 (see [R2] below).
Revision 3 (6/10/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with updated subtask schedules and travel (see [R3] below).
Revision 4 (1/7/09): Discontinues Subtask 2.1 due to NASA funding constraints (see [R4] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

Overall Requirement: The Contractor shall provide monthly technical progress reports and full financial reports at the individual subtask level to the Task Technical Monitor.

Subtask 2.1 - Damage Science and NESC Support: [R4]***Discontinued***

Subtask 2.2 – Structural Analysis and Design: 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. The subtask requirements are as follows:

a. Structural Analysis and Design Support

- 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.
- The Contractor shall create local FEM models for investigating design concepts, damage tolerance, thermal cracking, and thermal mismatch.
- Drawings, boundary conditions, and loading conditions will be provided by the NASA monitor.
- Finite element models will be reviewed by NASA technical monitor and the Contractor shall incorporate the comments into the structural model.

b. (NOC) Structural Mechanics Test and Analysis Support

The Contractor shall provide analysis and test support for research activities in structural mechanics and structural dynamics. Areas of support will include but are not limited to the following areas:

- Damage tolerance and durability analyses of composite aircraft and spacecraft structures and structural components
- Development of rapid analytic solutions for structural mechanics problems
- Structural response of composite aircraft, spacecraft, or space transportation systems with and without stiffness discontinuities
- Evaluation of failure criteria for laminated composite structures
- Nonlinear structural analysis of built-up structural systems.
- Nonlinear dynamic analysis of metallic and composite aircraft and spacecraft.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

Deliverables:

- All the finite element models that have been created.
- The results (e.g., plots of deformed shape, stresses, and strains) of the finite element analyses.
- Monthly progress reports.
- A final report documenting the analysis results.

Schedule:

Drafts/revisions of contractor report due quarterly
All work is to be completed by December 31, [R3]2009

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS:

Complete structural analyses and document results for various design concepts delivered throughout contract performance and completed by December 31, [R3]2009.

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

Subtask 2.3 - Software Engineering: The Contractor shall provide software engineering, development, and maintenance functions for web-based analysis tools, ABAQUS user subroutines R2~~implementing the Inverse Finite Element Method (IFEM)~~, the Computational Mechanics Testbed (COMET-AR) software system, and the DDTRB web sites. The subtask requirements are as follows:

a. Web-based analysis tools for radiation analysis and shielding design

- R2~~The Contractor shall continue to participate in the development of a replacement software architecture for the SIREST web site.~~
- The Contractor shall perform task collaboration with contractors, grantees, and civil servants on the Radiation Design Tools Team.
- The Contractor shall participate in the design, modeling, and implementation of the overall architecture, data flow, database content and interface, application server, and user interface.
- The Contractor shall develop an automated system of unit- and complete-build-tests for verification and validation of both the FORTRAN side and the web-side of the tool.

b. Integration of computational structures and mechanics analytical methodologies into quality working code. R2(Deleted)

c. 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 provide maintenance of the source and executable of the Computational Mechanics Testbed (COMET –AR) software system
- The Contractor shall 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 DDTRB personnel.
- The Government will notify the Contractor by email of release requests for the COMET-AR software system. 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.

c. Web-site development and maintenance

- The Contractor shall implement Web-based applications for DDTRB management functions within the framework of the DDTRB web page.

- The Contractor shall develop and deploy DDTRB 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.

Reporting Requirements: The Contractor shall provide monthly reports concerning software change requests, problem reports, code distributions, system updates, and web site changes.

The Contractor shall provide quarterly reports on software enhancement, documentation change requests, and acceptance test results.

2.3.1 Milestones (Optional):

- [R3]~~June, [R2]2008: Web tool for radiation analysis and design.~~

2.3.2 Deliverables and Schedule (Required):

Deliverables:

- CVS repository of COMET-AR software containing history of changes to all files in the system.
- The DDTRB external and internal web sites on a DDTRB host computer accessible to larcnet.
- Monthly reports on code and documentation changes and distributions.

Begin [R2] block deletion

- ~~IFEM methods shall be integrated and demonstrated in ABAQUS Source code and installation procedures for the implemented IFEM methods.~~
- ~~Draft Contractor reports on the implementation and validation of IFEM methods in ABAQUS.~~
- ~~User documentation for processors and procedures developed for IFEM methods implemented in ABAQUS, in MS Word format.~~

End [R2] block deletion

- Monthly reports on changes to the DDTRB web sites.
- Continuous input of contractor-developed source code and meta data into the version control system used for the Radiation Design Tools Project along with accompanying unit tests.

Schedule:

Deliverable	Description	Date
3.1	CVS Repository of COMET-AR code	Continuous
3.2	The CSMB external and internal web sites on an CSMB host computer accessible to larcnet.	Continuous
3.3	Monthly reports on code and documentation changes and distributions	Monthly
3.4	[R2>]~~IFEM methods integrated and demonstrated in ABAQUS and MATLAB~~	~~June 30, 2007~~
3.5	~~Draft Contractor reports on the implementation and validation of the IFEM methods in ABAQUS and MATLAB.~~	~~Nov. 30, 2007~~

3.6	~~User documentation for processors and procedures developed for the IFEM methods implemented in ABAQUS and MATLAB.~~	~~Dec. 31, 2007~~ <R2
3.7	Monthly reports on changes to the CSMB web sites	Monthly
3.8	Design and modeling reports/documents for the Radiation Design Tools Project	Quarterly
3.9	Source code and meta-data checked into version control	Continuous

2.3.3 Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS: All deliverables satisfied by Dec. 31, R3 2009

EXCEEDS: (one or more of)

- innovative contributions to the branch web sites
- R2 ~~innovative contributions to code development associated with the shape-sensing analysis techniques and interfacing with the ABAQUS code~~
- innovative contributions to design and modeling of R2 OLTARIS.

Subtask 2.4 – Study of Damage Processes in Metallic Materials: Study damage progression, corrosion fatigue and fracture with detailed fractographic analyses of advanced materials and aircraft components. The subtask requirements are as follows:

a. (NOC) Contractor shall develop a system for the loading of mechanical test specimens in the Environmental Scanning Electron Microscope (ESEM). The contactor shall be responsible for the integration of a loading frame and its control software into the ESEM and will develop testing procedures for this system that are consistent with safe and accurate operation of the ESEM. The contractor shall perform a minimum of 15 near tip damage studies using this system. These tests shall be conducted under test conditions to examine damage processes for fatigue crack growth as well as fracture of aluminum alloys as well as model metallic materials. 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.

b. The Contractor shall perform detailed fractographic examinations of test specimens tested as part of the Aircraft Aging and Durability Project. Approximately 10 to 20 specimens per year will be sectioned and examined in detail for evidence of fatigue cracking and corrosion. This will involve the careful sectioning of specimens. Detailed records will document the location and morphology of each damaged region. The Contractor shall report monthly on the progress of this testing.

c. The Contractor shall maintain the fractographic laboratory and coordinate all activities associated with the DDTRB 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.

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required):

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

Schedule:

Drafts/revisions of contractor report due quarterly
All work is to be completed by December 31, R3 2009

2.4.3 Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS:

- perform minimum quantity of fatigue/fracture in-situ tests (15 specimens per year)
- perform minimum quantity of fracture analysis (10 specimens per year)
- adherence to schedule and cost
- adherence to existing test procedures and the development of new procedures as required
- test data reports and laboratory maintenance log

EXCEEDS: completion ahead of schedule

Subtask 2.5 - Characterization of Advanced Materials: As part of the Computational Materials Program, Return to Flight, Exploration and the 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. The subtask requirements are as follows:

a. The 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, 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. The 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 DDTRB materials characterization laboratory. The Contractor shall report monthly on the progress of test apparatus development.

2.5.1 Milestones (Optional):

2.5.2 Deliverables and Schedule (Required):

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 [R1]~~December 31, 2007~~ December 31, [R3]2009.

2.5.3 Performance Metrics/Standards (Required - Meets, Exceeds):

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 2.6 Fatigue and Fracture Testing of Aerospace Structures: Determine fatigue crack growth and residual strength behavior of aerospace materials and structural configurations. Conduct tests on laboratory coupons and integrally stiffened specimens. The subtask requirements are as follows:

- 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.

2.6.1 Milestones (Optional):

2.6.2 Deliverables and Schedule (Required):

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
- 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 December 31, R3 2009.

2.6.3 Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- test data reports
- all tests in subtask a 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
- Completion of additional tests not included in test matrix

Subtask 2.7 Structural integrity of friction stir-welded aerospace materials: Experimentally evaluate friction stir-welded panels for aerospace applications. The objective of the subtask is to 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. The subtask requirements are as follows:

- 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).

2.7.1 Milestones (Optional):

2.7.2 Deliverables and Schedule (Required):

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."
- 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 December 31, [R3]2009.

2.7.3 Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- data 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
- completion of additional tests not included in test matrix

Subtask 2.n - Working Environment Safety and Organization)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R2]support the requirements of this task order.

Deliverable and Schedule: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents. Ongoing.

Performance Measurements:

Minimum Performance

- No repeated findings or incidents in six-month award fee period.

Exceeding Minimum Performance

- No cited findings or reportable incidents in six-month award fee period.

3. Government Furnished Items:

The Contractor will be provided use of and/or access to:

- UNIX workstations and associated CAD/CAE software
- Existing specialized fatigue testing equipment, optical microscopes, SEM (scanning electron microscopy) equipment, and associated special supplies located in the Materials Research Laboratory in Building 1205 and the Structures and Materials Laboratory in B1148.
- Other specialized measurement and testing equipment
- STAGS, COMET-AR, NASTRAN, LSDYNA and ABAQUS nonlinear structural analysis codes, PATRAN finite element preprocessor code, CVS configuration management software

- CAD drawings of NASA mission critical structures or structural components to be analyzed.
- Desk-top computers with specialized software
- Computer CPU time for structural modeling and analyses
- Test specimens
- Test specimen instrumentation
- Office space (as available)

4. Other Essential Information:

- 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 2.1 – 2.7: 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 2.1 – 2.7: **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.

- Travel: Participation as a member of the Structure [R2]TDT should be estimated at 20 hours per week. SDM to [R3]Palm Springs, CA in April 2009, The [R2]TDT Annual Meeting in August/September [R2]2008 and an additional trip to JSC, Travel Costs estimated to be [R3]$4,500

5. Security Clearance:

ITAR (International Traffic in Arms Regulations) apply, and LaRC ADP (Automated Data Processing) access is required.

Secret clearance required for Subtask 2.3. All other tasks are unclassified. US citizenship or Permanent Resident status is required for access to government computers.

6. Period of Performance:

Planned start date: [R1]1/25/07

Completion date: [R1]~~12/31/07~~ [R3]~~12/31/08~~ 12/31/09

7. NASA Task Management:

Technical Monitor (Required): Jonathan B. Ransom
M/S: 188E Phone: 757-864-2907

Other POC (Optional): Edward H. Glaessgen
M/S: 188E Phone: 757-864-8947

Subtask POCs (Optional):
Subtask 2.1: [R4] ***Discontinued***
Subtask 2.2: Thiagarajan Krishnamurthy , M/S 188E, Phone 757-864-3207
Subtask 2.3: Christopher A. Sandridge , M/S 188E, Phone 757-864-2816
Subtask 2.4: Stephen W. Smith, M/S 188E, Phone 757-864-8946
Subtask 2.5: Thomas S. Gates, M/S 188E, Phone 757-864-3400
Subtask 2.6: John A. Newman, M/S 188E, Phone 757-864-8945
Subtask 2.7: John A. Newman, M/S 188E, Phone 757-864-8945

TASK ORDER NUMBER: 048D3-NNL07AM75T Revision: 5 Change: 0 Date: November 7, 2008

Title: Simulation & Technology Evaluation of Electromagnetic Sensors

1. Purpose, Objective, or Background (Ref: NAS1-00135 Task 01RDH)

The Electromagnetics and Sensors Branch (ESB) has the responsibility of assessing radar, lidar, and other Electro-Optic (EO) sensor systems (collectively defined here as ElectroMagnetic Sensors (EMS)) in support of various focused NASA programs and projects. ESB researchers have a long history of providing ground-breaking research, development, and deployment of EMS technologies for a variety of ground-based, airborne (both military and private/commercial civilian) and space-borne platforms. These technologies have been used to detect, locate, and assess the severity of a wide range of aviation hazards (including wind shear, wake vortices, turbulence, terrain-avoidance, runway objects, and airborne traffic). Additionally and separate from aviation safety, ESB researchers have investigated various EMS technologies to remotely measure a wide variety of atmospheric or terrestrial properties (including soil moisture, oceanic salinity, sea state/winds, and polar ice mass).

The purpose of this task is to provide ESB researchers with technical support (described below) during the research and development of the various EMS technologies and systems. The highly-specialized nature of this support requires Contractor personnel with experience and familiarity with RF/Electro-Optic systems, including ground-based/airborne/space-borne radars/lidars/radiometers, measurement techniques associated with these technologies, and a wide breadth and depth of the kinds of software developed for these systems. ESB assessment of candidate EMS systems will be accomplished through simulations and direct measurements. This Task will support both the simulation and measurement components of the ESB mission as well as the specific requirements established by the individual focused programs.

Revision 1 (4/30/07): Adds vehicle relocation requirements in subtask 2.4 and updates the initial task order start date to January 25, 2007 (see [R1] below).

Revision 2 (8/6/07): Extends the period of performance three months to December 31, 2007 in continuation of NASA's support requirements (see [R2] below).

Revision 3 (11/28/07): Extends the period of performance 9 months to 9/30/08 in continuation of NASA's support, and clarifies safety and organization Subtask 2.n (see [R3] below).

Revision 4 (6/3/08): Extends the period of performance 3 months to December 31, 2008 in continuation of NASA's support and adds deliverables with metrics to Subtask 2.3. Note: Temporary WYE increase may be necessary for the added deliverables. (see [R4] below)

Revision 5 (11/07/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support for ongoing requirements (see [R5] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

This Task will be divided into four (4) subtasks in order to provide a structure for the diversity of work performed and facilitate communicating the requirements and schedules for the various deliverables. Each subtask is focused on a different aspect (skill set) required of the Contractor: software development, database management, EMS facility maintenance, and EMS measurements. Some subtasks have requirements, deliverables, and/or schedules specific to a single focused program; these subtasks have their requirements delineated for each focused program.

2.1 Software Development

The Contractor shall support the EMS simulation capability by developing software modules, validating

these models, and performing data analyses/visualization. The Contractor shall document all delivered software through written reports (informal, electronic documents containing (but not limited to): purpose, software design, input file / interface specifications, output format, and exemplary case runs).

2.1.1 Deliverables and Schedule:

2.1.1.1 Aviation Safety - Integrated Intelligent Flight Deck (IIFD)

2.1.1.1.1 The Contractor shall develop MATLAB module capable of providing interpolated platform state data from recorded flight data contained within the EMS Data Archive. (Requested delivery by 04/01/07)

2.1.1.1.2 The Contractor shall develop MATLAB program capable of producing a complex voltage (I/Q) signal representative of a measured echo response from an airborne radar. (Requested delivery by 09/30/07)

2.1.1.2 Earth Science Technology Office - Radar Attenuation by Oxygen Barometric Sensor (RAOBS)

2.1.1.2.1 The Contractor shall develop software capable of configuring the RAOBS radar, recording the measurements, and time tagging the recorded data. (Requested delivery by 06/01/07)

2.1.1.2.2 The Contractor shall develop data visualization program capable of synchronizing recorded platform state data, GPS position information, and RAOBS measurements. The program shall depict the platform location and instrument orientation along with measured RAOBS data. (Requested delivery by 08/01/07)

2.1.1.2.3 The Contractor shall develop software module capable of calculating NRCS from recorded RAOBS measurements. (Requested delivery by 09/01/07)

2.1.2 Performance Metrics/Standard

For deliverables 2.1.1.1.1, 2.1.1.1.2, 2.1.1.2.1, 2.1.1.2.2, and 2.1.1.2.3 the following performance metric will be applied:

Meets Standard: The Contractor consistently provides software modules/programs (including the software documentation) by the requested delivery date.

Exceeds Standard: The Contractor consistently provides results one week or more ahead of the requested delivery date.

2.2 Database Management

The Contractor shall design, organize, and maintain the growing data archive created by current ESB 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). The Contractor shall provide operator support for the ESB Data Archive delivered under this subtask. 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 ESB 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.

2.2.1 Deliverables and Schedule:

2.2.1.1 The Contractor shall provide an informal plan (eg, written document) which describes the organization and operation of the ESB Data Archive. This plan should reflect any foreseen

changes to the archive and address any operational issues experienced or anticipated, along with suggested remediation. (Requested delivery by 05/01/07)

2.2.1.2 (NOC) The Contractor shall oversee the operations of the ESB Data Archive including the addition of new data recordings, duplication of stored data, and the withdraw of data recordings from the archive. (Requested operation (eg, addition, duplication, or retrieval of data recording) shall be completed within 40 work-hours of request)

2.2.1.3 (NOC) The Contractor shall maintain an electronic log of the data recordings contained in the ESB Data Archive. Updates to this electronic log shall be completed prior to the release of the requested data. (Requested operation (eg, addition, duplication, or retrieval of data recording) shall be completed within 40 work-hours of request)

2.2.2 Performance Metrics/Standard

For deliverable 2.2.1.1 the following performance metric will be applied:

Meets Standard: The Contractor provides the report by the requested delivery date.

Exceeds Standard: The Contractor provides the report one week or more before the requested delivery date.

For deliverable 2.2.1.2 the following performance metric will be applied:

Meets Standard: The Contractor consistently completes the requested archive operation within the 40 work-hour window.

Exceeds Standard: The Contractor consistently completes the requested archive operation within a 20 work-hour window.

For deliverable 2.2.1.3 the following performance metric will be applied:

Meets Standard: The Contractor consistently completes the updates to the electronic log within a 40 work-hour window.

Exceeds Standard: The Contractor consistently completes the requested archive operation within a 20 work-hour window.

2.3 EMS Facility Maintenance

The Contractor shall maintain the functionality of the ESB laboratories used by focused NASA programs (e.g., the "roof-top" radar lab (rm 204), the "systems integration" lab (rm 142), the mobile research vehicle (RV), and the millimeter-wave measurement facility). These labs already exist and are currently being utilized by ESB researchers; the Contractor shall develop plans and procedures to allow continued and future EMS measurements and ESB operations. This subtask will require infrequent, small procurements by the Contractor to maintain the functionality of these facilities. The Contractor shall identify these procurements in advance and additional funding will be authorized by the Government to meet these obligations.

2.3.1 Deliverables and Schedule:

2.3.1.1 The Contractor shall produce and maintain a ESB EMS facilities work plan, which describes the lab processes and hardware/software utilization. This plan shall include: recommendations regarding keep/excess of existing equipment, suggested changes to the lab/facility design and/or procedures to improve operations, and suggested upgrades to meet program requirements. (End of CY-quarters)

2.3.1.2 (NOC) The Contractor shall implement the recommended changes (as approved by

authorized ESB personnel). (Specific upgrade/change schedules will be negotiated prior to authorization)

2.3.1.3 The Contractor shall oversee the operations of the specified ESB facilities, maintain a safe work environment, and be responsible for the general organization of the specific lab/facilities as they support the ongoing research. Also see 2.n below for more general requirement. (Daily requirements but no specific scheduled delivery)

Begin [R4] block addition

2.3.1.4 Recent inspections and maintenance by the Contractor (performed in conjunction with this subtask) have uncovered aging issues in the current ESB mobile research vehicle. Consequently, the government must either relinquish this vehicle/capability OR modify/replace this vehicle. The Contractor shall develop a plan to:
(i) modify/up-grade the current mobile research vehicle, AND
(ii) replace the research vehicle (including modifications to support ESB research).
The Contractor shall provide this plan and recommendations for this vehicle within 90 days of this Task modification. The Contractor should anticipate one travel requirement in the course of this assignment. Consequently, it is expected that the Contractor's budgetary estimate (associated with this Task change) will include travel on the order of one-man-week and two cross-country airfares.

23.1.5 The Contractor shall modify the research vehicle (identified in deliverable 2.3.1.4) to provide research capabilities commensurate with the existing vehicle. Modifications to this vehicle shall be completed in accordance with project milestones (ie, prioritized and meeting project requirements). The fully functional research vehicle shall be available by 31 December2008.

End [R4] block addition

2.3.2 Performance Metrics/Standard

For deliverable 2.3.1.1 the following performance metric will be applied:

Meets Standard: The Contractor provides the facility work plan each quarter.

Exceeds Standard: The Contractor provides the facility work plan as part of the monthly status report.

For deliverable 2.3.1.2 the following performance metric will be applied:

Meets Standard: The Contractor implements approved/authorized changes within requested delivery schedule.

Exceeds Standard: The Contractor implements approved/authorized changes within 90% or less time than the approved schedule.

Begin [R4] block addition

For deliverable 2.3.1.4 the following performance metric will be applied:

Meets Standard: The Contractor provides the plans and recommendations within 90 days of this Task modification.

Exceeds Standard: The Contractor provides the plans and recommendations within 30 days of this Task modification.

For deliverable 2.3.1.5 the following performance metric will be applied:

Meets Standard: The Contractor completes the modifications and returns the research vehicle to research-operational status by 31 December 2008.

Exceeds Standard: The Contractor completes the modifications and returns the research vehicle to research-operational status by 01 October 2008.

End [R4] block addition

2.4 EMS Measurements

The Contractor shall participate in EMS measurements both at LaRC and at deployment sites. The Contractor shall operate EMS measurement equipment, data acquisition systems, real-time processors, and other equipment in support of EMS measurements conducted by ESB researchers. The Contractor shall support approved deployments with measurement logistics, data acquisition/reproduction/analyses, and coordination of field activities. [R1>]The Contractor shall relocate mobile test vehicles and support vehicles in accordance with negotiated schedules and in coordination with authorized ESB personnel. These vehicles are currently tagged NA-000792 and NA-000720, but NASA will update the list of specific vehicles via NOC process as needed.[<R1]

2.4.1 Deliverables and Schedule:

Although more deliverables are expected to be added to this subtask, there is insufficient information at this time to specify any more than the following:

2.4.1.1 The Contractor shall provide logistics support for RAOBS antenna alignment/calibration. This support will require the Contractor to relocate the RAOBS instrument from LaRC to the GTRI – Cobb County Facility, where it will undergo antenna alignment and an instrument calibration at that unique facility. The Contractor will be required to transport the instrument to/from the GTRI facility, stay in the immediate area for approximately one week, and then transport the modified RAOBS instrument back to LaRC.

2.4.2 Performance Metrics/Standard

For deliverable 2.4.1.1 the following performance metric will be applied:

Meets Standard: The Contractor transports the RAOBS instrument to/from the GTRI facility.

Exceeds Standard: The Contractor participates in the alignment and calibration of the RAOBS instrument, and provides an informal summary report describing the results of these tests and modifications.

2.n Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R3]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Contractor will be given access to any ESB computer hardware/software required to perform this task.

4. Other Essential Information:.

5. Security Clearance: All work will be unclassified. The Contractor may be required to handle proprietary data in the execution of this Task. All personnel assigned to this Task will be required to sign non-disclosure agreements prior to gaining access to proprietary data.

6. Period of Performance:

Planned start date: [R1]25 January 2007

Completion date: [R2]~~30 September 2007~~
[R3]~~31 December, 2007~~
[R4]~~30 September 2008~~
[R5]~~31 December 2008~~
31 December 2009

Yearly extensions are expected but are contingent upon continued funding by NASA programs.

7. NASA Task Management:

Technical Monitor (Required):
Steven Harrah
M/S: 473
Phone: 41805

Other POC (Optional):
Ivan ClarkM/S: 473
Phone: 41500

TASK ORDER NUMBER: 004E5-NNL07AM76T Revision: 2 Change: 0 Date: July 29, 2008

Title: Flight Operations Support Center (FOSC)

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS Task 02E5A)

The Flight Operations Support Center (FOSC) has a continuing responsibility to support research missions out of the Langley Research Center and other NASA and Military facilities by receiving real and near-real time data, video and audio into the FOSC for use by NASA, contractor, and industry researchers. Each mission typically requires approximately 500 to several thousand data parameters, 1-3 video sources and 6-12 audio channels.

In performance of this task the Contractor will have the following responsibilities:

- Provide operations support for controlling and monitoring research missions 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.
- Provide mission support in the form of data, video and comm (voice/ coordination circuits) to the Hypersonic Boundary Layer Transition (HyBOLT) and Inflatable Research Vehicle Experiment (IRVE) projects.
- Provide operations coordination and mission operations implementation support for NASA's research activities to enable NASA LaRC to conduct mission 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 mission support service activity is maintained by the Contactor and reviewed by the Technical Monitor.

Revision 1 (10/29/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support with new Technical Monitors and clarifies safety and organization subtask 2.n requirements (see [R1] below).

Revision 2 (7/29/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall:

a. Design, install, checkout, operate, maintain, and troubleshoot all computer systems within the FOSC, as well as interface subsystems (Veridian System 3000 and Ring Buffer Network Buss System Support, FOSC Gig Network). Provide consultation services in the setup and operation of DOS and UNIX computer systems.

b. Design, install, operate and maintain all video systems (full motion, compressed, editing and tape dubbing). Assist in research video system design.

c. Design, install, operate and maintain all UHF, VHF radio, cable TV head-end communication systems and close circuit TV head-end system 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 NASA and Military 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 several missions 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. 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.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

a. All required recordings of data, video, and audio as requested by the researchers for each flight (at the rate of several missions per week), to include post-data processing.

b. All video post processing dubs and analysis including any video editing.

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds):

All necessary data, audio, video and communication systems up and running for each flight that support is requested at the rate of several missions per week. Target is 98% FOSC systems availability; no less than of 98% data and video documentation recorded.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1] support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Contractor will have access to all Government provided data, video, audio, and maintenance equipment in the FOSC.

4. Other Essential Information: During a typical mission, data, video and audio systems will be operated concurrently. A continuing awareness of the latest technology is a critical task aspect. Contractor will stay current with the latest communications security (COMSEC) by attending LaRC Security COMSEC briefings. Contractor will be required to fly aboard NASA and commercial aircraft to meet local and remote

mission requirements.

5. Security Clearance: A secret clearance will be required.

6. Period of Performance:

Planned start date: January 24, 2007 Completion date: R1~~December 31, 2007~~
R2~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): R1**Richard J. Yasky**
M/S: 255A Phone: 757 864-2251
Technical Monitor (Required): R1**Barbara S. Trippe**
M/S: 255A Phone: 757 864-3874
Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 004D2-NNL07AM77T Revision: 3 Change: 0 Date: September 21, 2007

Title: MISSE 6 Analysis and Design and Drafting Support

1. Purpose, Objective, or Background (Optional)

This SOW is in support of the Materials International Space Station Experiment 6 (MISSE). LaRC is responsible for design, fabrication, integration, flight acceptance testing, and delivery to KSC the MISSE experiments, experiment containment hardware, sidewall carriers, and the flight support hardware that mounts to the Light Weight Adapter Plate Assembly (LWAPA). This hardware constitutes the experiments or will support the experiments during launch, deployment, and descent of MISSE 6 to/from the International Space Station (ISS) aboard the STS vehicle. LaRC civil servants and contractors will work as an integrated team for this effort.

This SOW is to provide contractor personnel to perform structural analysis, fracture analysis, as well as, design and drafting tasks in support of the MISSE 6 design and development.

Applicable Documents:

1. MISSE 6-068 Structural Verification Plan
2. MISSE 6-071 Fracture Control Plan

These documents are currently in the draft stage and will likely remain in the draft stage throughout all Phases of this contract. Both documents will reference higher level requirement documents that will drive the loads, and interfaces of the flight hardware. If at any time a change in requirements prevents the contractor from meeting the terms of this contract, notify the COTR immediately.

Revision 1 (3/20/07): Extends the period of performance of all subtasks to September 30, 2007, updates schedule accordingly, and clarifies design review requirements (see [R1] below).
Revision 2 (5/18/07): Requirements removed from Subtask 3 due to funding constraints and refocused as Subtask 4 (see [R2] below).
Revision 3 (9/21/07): Extends the period of performance and schedule 3 months to December 31, 2007 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R3] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1. MISSE 6 Structural Analysis (Subtask 1):

POC: Dave McGowan M/S: 190 Phone: (757) 864-4916

2.1.1. The Contractor shall perform structural analysis in support of the MISSE 6 flight hardware design and development. These analyses will involve the structural modeling or updating of existing models of the hardware and analysis of these models using PATRAN/NASTRAN structural analysis tools. In addition, some handbook calculations will be required. The Contractor shall perform these analyses, interpret results, and report these results to NASA technical points of contact and MISSE 6 system designers. The Contractor shall provide structural design consultation with the primary MISSE 6 system designers. There are presently three primary components to the MISSE 6 flight hardware, the Passive Experiment Containers (PECs) w/ experiment trays, the Sidewall Carriers (SWC), and the Flight Support Equipment that will be integrated to the Light Weight Adapter Plate Assembly (LWAPA). The design and analysis of these components will be phased on a priority basis, which will be defined and updated as the project progresses. Therefore, the Contractor must be flexible in addressing work on the various components to meet this ongoing prioritization.

The primary components of this subtask are as follows:

2.1.2. **Identify, Capture, and Understand System Requirements Impacting the MISSE 6 Structural Analysis** – The Contractor shall identify and assemble a subset of MISSE 6 system requirements that will be used in the structural evaluation of the MISSE 6 hardware. All subsequent structural analyses and documentation shall be formulated and executed so as to quantitatively determine that these requirements have or have not been met. This subtask will be performed in conjunction with other NASA and Contractor team members to ensure that everyone is aware of and working to the same set of requirements.

2.1.2.1. **Deliverables:**

Documentation of Requirements Used to Complete the Structural Analysis: Documentation of requirements identified and used to perform structural analyses and evaluation in narrative format using Microsoft Word or other suitable word processing software.

2.1.2.2. **Schedule:**

January 22 through [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007***.

2.1.2.3. **Metrics:**

Delivery of requirements documentation.

2.1.2.4. **Standards:**

Meets – Documentation delivered by [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007***..

Exceeds – Documentation delivered on or before [R1]~~February 16, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007***..

2.1.3. **Interface with MISSE 6 System Designers** – The Contractor shall attend periodic status meetings to discuss, evaluate, and provide feedback on the impact of design details on the structural performance of the system. The Contractor shall provide detailed analysis results to the designers and consult on the adequacy of the design to meet all structural requirements.

2.1.3.1. **Deliverables:**

Technical status, discussion and issues included in Bi-Weekly Status Reports.

2.1.3.2. **Schedule:**

January 22 through [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007***.

2.1.3.3. **Metrics:**

Delivery of Bi-Weekly Reports and supporting data.

2.1.3.4. **Standards:**

Meets – Summary technical status included in bi-weekly written reports.

Exceeds – Bi-Weekly face-to-face meeting with Structural and Thermal Systems Branch (STSB) Branch Head to discuss analysis status and progress.

2.1.4. **Perform Structural Analysis of MISSE 6 Hardware** - Using designer input, the Contractor shall modify existing or develop suitable structural models and perform analyses per requirements identified in Subtask 1.0 section 2.1.2. All FEM developed for this effort shall be placed under configuration control, archived, and delivered with the final report. Analyses will require a range of expertise and technique from relatively simple handbook analysis to highly detailed Finite Element Modeling (FEM) using state-of-the art analysis tools such as PATRAN and NASTRAN.

2.1.4.1. **Deliverables:**

Structural Models Exercised in the Structural Analysis – Documentation of models used to perform handbook analyses and finite element models used to complete more detailed FEM analyses.

Interim Structural Analysis Results – Informal presentations and written documentation of analysis results at team meetings, via e-mail communication, informal status reports, PowerPoint presentations, etc.

2.1.4.2. **Schedule:**

January 22 through [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007***.

2.1.4.3. **Metrics:**

Delivery and presentation of analysis results at team meetings.

2.1.4.4. **Standards:**

Meets – Attends all team meetings or sends an analysis representative.

Exceeds – Regularly presents analysis status and findings at team meetings.

2.1.5. **Present and Document Results** – The Contractor shall present structural analysis results as they become available. Documentation should focus on the satisfaction of requirements specified in Subtask 1.0. The Bi-Weekly Status reports shall document technical status and summary budget information to include work hours and dollars expended, budget expended to date, budget remaining, and estimate of cost to complete task. Written Bi-Weekly and Final status reports shall be provided per the deliverable schedule below. PowerPoint format is suitable for status meeting presentation, but a more formal narrative format, of the Contractors choosing, shall be used for the Monthly and Final reports.

2.1.5.1. **Deliverables:**

Final Technical Report – Formal written report summarizing task objectives, analysis results, findings, and recommendations.

2.1.5.2. **Schedule:**

Bi-Weekly Reports due by the second and forth Friday of each month.

Final Report due [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007***.

2.1.5.3. **Metrics:**

Delivery of status documentation.

Standards:

Meets – All documentation delivered by due dates.

2.2 MISSE 6 Fracture Analysis (Subtask 2)

POC: Dave McGowan M/S: 190 Phone: (757) 864-4916

2.2.1. The Contractor shall perform fracture analysis on parts and assemblies considered to be fractural critical as identified by the requirements stated in the MISSE 6-071 Fracture Control Plan.

2.3 MISSE 6 Development and Design (Subtask3) [R2](Requirements removed from Task Order due to funding constraints and refocused below as Subtask 4)

2.4. MISSE 6 support for Reviews (Subtask 4) [R2](Refocused from previous Subtask 3)

POC: Karen Gibson M/S: 432 Phone: (757) 864-7116

2.4.1. The Contractor shall support MISSE 6 Reviews

2.4.1.1. The Contractor shall be present at project design reviews.

- MISSE 6 CDR - April 17, 2007
- [R2]MISSE 6 Verification Loads Review (VLR) - ~ Aug. 2007

2.4.1.2. The Contractor shall provide design and engineering data required to generate presentation slides for reviews.

2.n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R3]***support the requirements of this task order***.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Government will provide office space equipped with phone and internet access.

4. Other Essential Information:

Maximum travel to support MISSE 6 is estimated as follows:

1. Subtask 1 & 2 – Up to 3 trips

One trip is estimated as one person for three nights to Texas.

5. Security Clearance: A security clearance is not required for this task.

6. Period of Performance:

Subtask 1 (Structural Analysis)

Planned start date: January 22, 2007 Completion date: [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007.***

Subtask 2 (Fracture Control Analysis)

Planned start date: January 22, 2007 Completion date: [R1]~~February 23, 2007~~ [R3]~~September 30, 2007~~ ***December 31, 2007.***

Subtask 3 (Development and Design) [R2]Removed from Task Order

[R2]**Subtask 4 (Support for Reviews)**

Planned start date: January 22, 2007 Completion date: R1~~March 23, 2007~~
R3~~September 30, 2007~~
December 31, 2007.

7. NASA Task Management:

Technical Monitor (Required): Karen Gibson
M/S: 432 Phone: (757) 864-7116

Other POC (Optional):

Structural Analysis POC (Subtask 1): David McGowan
M/S: 190 Phone: (757) 864-4916

Fracture Control Analysis POC (Subtask 2): David McGowan
M/S: 190 Phone: (757) 864-4916

Development and Design POC (Subtask 3): Karen Gibson
M/S: 432 Phone: (757) 864-7116

TASK ORDER NUMBER: 049D3-NNL07AM78T Revision: 4 Change: 0 Date: October 31, 2008

Title: Ares I Uncertainty Quantification Support

1. Purpose, Objective, or Background (Optional)

This work will support the Ares I Program Office and the Configuration Aerodynamics Branch at the NASA Langley Research Center in uncertainty quantification analyses of experimental and computational aerodynamics results for the Ares I launch vehicle

Revision 1 (9/25/07): Extends the period of performance 12 months in continuation of NASA's support, re-designates safety and organization subtask as 2.n and clarifies its requirements, updates the initial task order start date to February 6, 2007 (see R1 below).

Revision 2 (2/26/08): Adds pressure and loads distributions analysis and reporting requirements and updates GFI (see R2 below).

Revision 3 (8/22/08): Extends the period of performance 12 months to September 30, 2009 in continuation of NASA's support (see R3 below, Section 6).

Revision 4 (10/31/08): Adds wind test and specialized training support (see R4 below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

2.1 – (NOC) Uncertainty Quantification Analyses and R4 ***Other Support***:

- The Contractor shall perform analyses of experimental results for the Ares I launch vehicle for the purpose of estimating repeatability, reproducibility, the true value and associated uncertainty.
- The Contractor shall perform analyses of computational results for the Ares I launch vehicle together with corresponding experimental validation data for the purpose of validating the computational process and results and for estimating the uncertainty associated with computational predictions.
- The Contractor shall generate formal and informal reports of the above analyses, including presentations to staff and managers.
- R2> The Contractor shall perform analyses of experimental and computational results for the pressure distributions and loads distributions for the Ares I launch vehicle for the purpose of estimating repeatability, the true value, the associated wind tunnel uncertainty and the CFD validation error. This effort shall include generation of formal and informal reports of the pressure and loads analyses, including presentations to staff and managers. <R2
- R4> The Contractor shall provide wind tunnel test support.
- The Contractor may be required to provide specialized training for work on some projects. <R4

2.1.1 Deliverables and Schedule (Required):

The Contractor shall provide a report, including budget and costs, to task monitor within five workdays of NOC completion.

2.1.2 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets Standard: All analysis work and reporting meets government standards and is within schedule.

Exceeds Standard: All analysis work and reporting meets government standards and is ahead of schedule.

TASK ORDER NUMBER: 049D3-NNL07AM78T Revision: 4 Change: 0 Date: October 31, 2008

Title: Ares I Uncertainty Quantification Support

[R1]2.n - Working Environment Safety and Organization:

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: Desktop computer , LaRCnet account [R2]and some software such as Matlab and NEAR RS.

4. Other Essential Information:

5. Security Clearance: Ares I Program data is considered Sensitive But Unclassified and must be treated as such.

6. Period of Performance:

Planned start date: [R1]February 6, 2007 Completion date: [R1]~~September 30, 2007~~ [R3]~~September 30, 2008~~ September 30, 2009

7. NASA Task Management:

Technical Monitor (Required): Michael J. Hemsch

M/S: 499 Phone: (757) 864-2882

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 002C2-NNL07AM79T Revision: 2 Change: 0 Date: April 28, 2009

Title: ARES I-1 Integrated Hazard Analysis

1. Purpose, Objective, or Background (Optional)

ARES I-1 is the first flight test being performed in support of Constellation Program. The Flight Test Vehicle (FTV) is being built by multiple Centers and contractors and is being assembled, integrated, tested and launched from KSC/AF Range. [R1]The elements are referred to as Integrated Product Teams or IPTs. [R1]The IPT responsibilities are as follows: crew module and launch abort system mass simulator [R1](CM/LAS) – LaRC; Upper Stage mass simulator, including inter-stage structure – GRC; Active First Stage, skirt extensions, frustrum and recovery systems – MSFC & ATK; Avionics – MSFC, managed by Jacobs Sverdrup, provided by Lockheed Martin; Roll Control System – MSFC, provided by Teledyne Brown, [R1]Ground Operations (GO) and Ground Systems (GS) - KSC.

LaRC has been tasked to do the engineering necessary [R1]for vehicle integration and has an office, [R1]Systems Engineering and Integration (SE&I), located here at LaRC for such purposes. LaRC Safety and Mission Assurance (SMA) has been assigned to perform the vehicle integration efforts for the FTV SMA deliverables and work, and coordinate with KSC/MSFC for SMA related ground operations. This assignment will require technical expertise and support in reviewing, assessing and providing the technical inputs towards developing, [R1]maintaining and tracking an integrated hazard analysis.

[R1>]The work in this task in both urgent and compelling. This flight test is the first flight vehicle in support of the Agency's Constellation Program and has an aggressive schedule. This safety work is a key component of the overall success and the Project's approval to go forward. Based on the imminent schedule demands, this work needs to start as soon as possible to avoid any unnecessary delays. Starting sooner than the stated October 29, 2007 is acceptable.[<R1]

Revision 1 (10/9/07): Re-activates the task order and extends the period of performance 19 months to April 30, 2009 in continuation of NASA's support with new Technical Monitor, added POC, and updated requirements (see [R1] above and below).
Revision 2 (4/28/09): Extends the period of performance 5 months to September 30, 2009 to accommodate any slippage in the Ares I-X launch date (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Integrated Hazard Analysis:

The Integrated Hazard Analysis includes the integration of all the above elements, ground operations and processing, including pad roll-out, pad operations, launch, flight and recovery operations. The Contractor shall, coordinate and perform the analysis required to have an integrated hazards analysis. The hazard development process involves having various working group meetings to ensure complete coverage of the hazards, insure hazards are consistent across interfaces, includes Failure Mode Effects Analysis (FMEA) results and has applicable analysis, testing and inspections specified as controls. [R1]SE&I and KSC personnel are integral to the hazard development process. Civil servants out of LaRC Mission Assurance Branch will serve as the government technical POC and will direct and coordinate with the Contractors as necessary to perform the hazard analysis process.

Begin [R1] block update The required format for hazard reports and individual hazard sheets with level of detail for each Phased review is prescribed in CxP 70038.The Contractor shall perform the following activities in support of the integrated hazard analysis:

1. Further develop the existing ARES I-X flight test integrated fault tree as necessary, Generate the required integrated hazard sheets/reports and supporting text.
2. Support the ARES I-X Safety Working Group (SWG). Support shall include developing agendas, e-

mailing/scheduling the meetings, tracking inputs from the various IPTs, assigning actions and following up on past actions. Government POC may require the SWG meetings to be chaired by the Contractor when he/she is unable to participate.

3. Ensure required integrated inputs, including integrated hazard formats where applicable, are communicated to the SWG members. For this project, multiple formats are anticipated for individual IPT hazards sheets, fault trees and FMEAs.
4. Review the IPT integrated hazard inputs for sufficient technical content and ensure that the safety controls are sufficient to meet the requirements. Provide assessments to the SE&I integration lead and the ARES I-X SMA lead as requested/required.
5. Participate in and support Technical Interchange Meetings (TIMs) and or Integration Working Groups in which safety issues will be or need to be addressed.
6. Participate in all Safety Reviews in support of the Constellation Safety and Engineering Review Panel (CSERP). Presenting integrated hazards, fault trees and status at the CSERP may be required as directed by the Government POC.
7. Develop and maintain a hazard tracking system for both updates to the integrated hazard sheets and in particular, for tracking/status of the controls (verification and validation) for the integrated hazards.
8. Review and assess supporting IPT hazard information, such as FMEAs, to determine complete coverage of integrated hazards and controls.
9. Depending on direction/requirements for an integrated FMEA at the SE&I SMA level, provide technical support required to satisfy integrated FMEA deliverables.

2.1.1 Milestones (Optional):

Roll Control CDR - Completed
Upper Stage CDR – October, 2007
CM/LAS CDR – November, 2007
Avionics – November, 2007
First Stage CDR – January, 2008
GO/GS CDR – January, 2008
Integrated Vehicle CDR - January, 2008.
System Acceptance Review (SAR) – September, 2008

2.1.2 Deliverables and Schedule (Required):

.

The Contractor shall provide all required deliverable documentation and reports to the task technical monitor in accordance with the following:

DELIVERABLES

Status Reports - Due Monthly

- Submit status report electronically via email to Task Technical Monitor by the last business day of the month.
- Include any SWG actions and status

Status inputs to the LaRC SE&I SMA Lead – Due weekly or as required

- Provide input to LaRC SE&I SMA Lead for (currently) weekly SMA telecoms

Up-to-date Integrated Hazards Fault Tree – Maintain Current

Integrated Hazard Reports (per CxP 70038) - Prior to scheduled CSERP phased safety reviews and

Integrated Vehicle CDR as noted below

- Report maturity to match Project/Safety Review phase
- Includes maintaining Integrated Hazard Reports current and up-to-date
- Phase II Integrated Hazards Report (Report + Individual Hazard sheets (also referred to as hazard reports) as per CxP 70038) to support the data drop for the Integrated Vehicle CDR – The vehicle CDR is currently scheduled for the end of January or the1st of February, 2008. Data drop dates are typically 2-3 weeks prior to the CDR.
- Phase III Integrated Hazard Report (Report + Individual Hazard sheets) – Conducted at the System Acceptance Review (SAR) for the vehicle, currently scheduled for September, 2008.

Safety Review Presentations - At scheduled CSERP phased safety reviews (Phase II and Phase III). Support may be required for individual IPT CSERP reviews as well.

Integrated Hazard Verification/Validation Tracking Log – Develop by December 3, 2007; Maintain current

- Develop Log
- Maintain Log
- May be required through the Operational Phase at KSC for those items still requiring tracking

End R1 block update

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: Produces the R1Integrated Hazard Report and Fault Trees as required by due date, technically complete up to the state of knowledge by R1Vehicle CDR. Final Hazard Report/Fault Trees produced R1when required; technically accurate, and includes good integration across elements and mission phases.

Exceeds: Produces the R1Integrated Hazard Report and Fault Trees R1when required, technically complete up to the state of knowledge by R1CDR, minimal number of RIDS. Final Hazard Report/Fault Trees technically accurate, include good integration across elements and mission phases R1and when required; minimal number of RIDS and rework; provides R1excellent support R1at meetings and reviews.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R1support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

CxP 70038 – electronic version

Begin R1 block update

Government produced fault trees and IHRs to date

IPT hazard reports and information as delivered to the Government; deliverables may be dependent on

proprietary/contract wording
End [R1] block update

4. Other Essential Information:
Begin [R1] block update

- All deliverables will be prepared in MS Office, with the exception of the integrated fault tree which is in CAFTA. If CAFTA is un-available to the Contractor, another suitable graphics or fault tree software may be used, if unable to work an arrangement for use of the Govt's CAFTA license. Possible work-around may be to mark up copies of the fault tree and have the government POC update in CAFTA.
- Non-Disclosure Agreement is required for all participants due to multiple IPT contractors
- Participation will be required in meetings, teleconferences, VITS/Webex as necessary.
- Travel is required to complete this task. It is estimated that there will be potential travel to LaRC, KSC, GRC, JSC, MSFC and possibly to ATK (Utah), LM (Denver) and TBE (Huntsville) to support meetings, TIMS and safety reviews. For planning purposes, 2 trips to each of the above locations with durations of 2 days each are anticipated and can be used for planning/budgeting purposes. Some events may be supported via telecon/Webex.
- Task needs to start immediately; sub-contractors and/or teaming companies are acceptable for staffing.

The Cost proposal needs to show a phasing in cost over the time span to aid as the number of people may flux from the start through the completion date. A minimum amount of support is anticipated after shipment of hardware to KSC.
End [R1] block update

5. Security Clearance: [R1]None Required; Non-disclosure agreements will be required when accessing Lockheed Martin, ATK and Teledyne Brown Hazard Reports and other company proprietary data.

6. Period of Performance:

Planned start date: [R1]March 9, 2007* Completion date: [R1]~~September 30, 2007~~
[R2]~~April 30, 2009~~
September 30, 2009

*Task reactivated to begin October 29, 2007

7. NASA Task Management:

Technical Monitor (Required): [R1]**Duane Pettit**
M/S: 305 Phone: 757-864-5224
Other POC (Optional): [R1]**David Helfrich**
M/S: 255A Phone: 757-864-4058

TASK ORDER NUMBER: 050D3-NNL07AM80T Revision: 6 Change: 0 Date: October 16, 2008

Title: Landing Dynamics Engineering Support

1. Purpose, Objective, or Background (Optional)

NASA Langley requires engineering support and expert consulting services in the specialty area of landing dynamics. In particular, NASA requires engineering expertise and leadership to define and perform friction testing including the associated data analysis; technician support for these activities is not required. Specific projects and related deliverables for the work to be performed are described as Sub-Tasks in this Task Order.

Revision 1 (5/8/07): Updates 2.2.1 Milestones and 2.2.2 Deliverables and Schedule and adds requirements as new Sub-Task 3 (see [R1] below).
Technical Direction 1 (11/6/07): This action shifts emphasis in early November 2007 from the Edwards AFB tests by reducing the support to 3 weeks instead of 6 weeks to allow the Contractor to immediately shift support to the Port Authority of New York and New Jersey (PA) as described in Revision 2 (see [TD1] below).
Revision 2 (10/29/07): Adds new requirements as 2.4 Sub-Task 4, updates milestones in section 2.2.1 and extends POP accordingly to March 1, 2008 (see [R2] below).
Revision 3 (1/18/08): Updates requirements of 2.3 Sub-Task 3 for current year, updates milestones in section 2.2.1, extends POP three months to May 31, 2008. Previously overlooked clarifications for safety and organization Subtask 2.1 and the initial task order start date of April 12, 2007 have also been added (see [R3] below).
Revision 4 (4/23/08): Revises final test dates for Sub-Task 2 and extends POP from May 31, 2008 to July 11, 2008 (see [R4] below).
Revision 5 (6/16/08): Adds new requirements as 2.5 Sub-Task 5 and extends POP from July 11, 2008 to October 31, 2008 (see [R5] below).
Revision 6 (10/16/08): Extends the Sub-Task 5 schedule, and accordingly the overall period of performance, 1 month to November 30, 2008 to enable NASA to thoroughly edit/review the draft final report. It is anticipated that this would be at no additional cost to NASA (see [R6] below).
Technical Direction 2 (10/23/08): Adds new primary Technical Monitor (see [TD2] below, Section 7)

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Discrete projects and their associated deliverables are defined as Sub-Tasks in this section.

2.1 Sub-Task 1: Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R3] support the requirements of this task order.

2.1.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.1.2 Required Date: Ongoing.

2.1.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

2.2 Sub-Task 2: Semi-Prepared Runway Operations II (SPRO-II) Friction Data

NASA Langley has an agreement with the U.S. Air Force (USAF) to provide landing dynamics expertise to support their SPRO-II project. The high level objectives or major milestones for this project are twofold: 1) identify the limits of C-17 aircraft ground operations on a variety of soil runways; and 2) develop measurement equipment/techniques to quickly ascertain in the field if an unprepared runway site is suitable

for C-17 aircraft takeoff and landing operations. A series of tests at several sites having different unprepared runway characteristics will be conducted during 2006-[R3]~~2007~~ 2008. NASA's role in this project is to determine how tire/soil friction performance impacts soil runway acceptability.

In order to complete this work for the USAF for the remaining three SPRO-II test sites, NASA requires engineering services with special expertise in landing dynamics be provided by the Contractor during the following activities:

- **MTTF Preparation:** The Contractor shall provide landing dynamics engineering expertise through the final design/manufacturing/assembly/check-out of the Mobile Tire Test Facility (MTTF) to ensure that the vehicle will be operational prior to the first series of tests. The deliverable for this phase of the work is Consulting Services.
- **Pre-Test Activities:** The Contractor shall provide landing dynamics engineering expertise to work in close cooperation with the USAF and Army to plan testing activities for each of three testing sites (Edwards AFB, Fort McCoy and Fort Chaffee). This planning will include defining the NASA equipment and NASA / Contractor personnel that are required to conduct the tests at each site, as well as preparing the equipment for testing. The Contractor shall participate in all NASA required safety reviews prior to deployment. The deliverables for this phase of the work shall be the Test Plan and the Test Procedure.
- **Test Activities:** The Contractor shall provide on-site landing dynamics engineering expertise at each of the test sites. The Contractor shall be responsible for coordinating operation of NASA equipment during the tests, and shall approve NASA equipment readiness for the required testing activities. The deliverable for this phase of the work shall be the Test Data.
- **Post-Test Activities:** The Contractor shall provide landing dynamics engineering expertise to perform data analysis for all test data collected. The deliverable for this phase of the work shall be a Test Report for each of the three series of tests and a Summary Report at the conclusion of the entire testing program.

2.2.1 Milestones: Major milestones for this activity are achieving operational readiness of the MTTF followed by each of the three series of tests. Actual testing dates are subject to USAF/Army readiness as well as site conditions. Approximate test dates and durations for planning purposes are provided below:

Begin [R1] block update

- **MTTF Operational:** 8 weeks concluding in May 2007
- **Fort McCoy Tests:** 6 weeks spanning June/July 2007
- **Fort Chaffee Tests:** 6 weeks spanning September/October 2007
- **Edwards AFB Tests:** [TD1>]3 weeks spanning ~~November/~~ [<TD1 R3]~~December 2007~~ [R4]~~April May 2008~~ May-June 2008

End [R1] block update

2.2.2 Deliverables and Schedule:

Prior to the commencement of SPRO-II testing activities, the Contractor shall provide the following deliverable:

- **Consulting Services:** Written and verbal engineering evaluations of and recommendations

for the final design/manufacturing/assembly/check-out of the MTTF to ensure vehicle readiness prior to the first series of tests. NASA anticipates that up to 80 hours of Consulting Services will be required on an intermittent basis prior to commencement of testing.

For each the three series of SPRO-II tests, the Contractor shall provide the following deliverables, subject to NASA review and approval:

- **Test Plan:** Text/figure document describing required tests and schedule for each site, equipment and staffing requirements for NASA to support these tests, and planned data products. This document shall be developed in close cooperation with the USAF, Army and NASA. The Test Plan shall be delivered in both electronic and hard copy forms [R1]2 weeks prior to first day of testing.
- **Test Procedures:** Text/figure document describing detailed activities to be performed at the test site. All testing activities that are required to produce repeatable test data shall be included in the procedure, including required equipment check-out. The Test Procedures shall be delivered in both electronic and hard copy forms [R1]1 week prior to first day of testing.
- **Test Data:** CD/DVD compilation of all test data taken by NASA along with all test run data summary sheets. All data required for independent data analysis shall be included. The Test Data shall be delivered in electronic form 1 week following the last day of testing.
- **Test Report:** A text/figure document describing test procedures, test/environmental conditions, data collected, data analysis techniques, data analysis results, technical conclusions and recommendations. Data analysis shall include correlation of NASA equipment friction test readings to C-17 aircraft RCR values, and an assessment of the major factors influencing the correlation. The Test Report shall be delivered in both electronic and hard copy forms 3 weeks following the last day of testing.

At the culmination of all testing, the following deliverable shall be provided by the Contractor, subject to NASA review and approval:

- **Summary Report:** A text/figure document summarizing all testing and data analysis that was conducted along with major conclusions and recommendations. The Summary Report shall be delivered 6 weeks following the last test conducted.

2.2.3 Performance Metrics:

Exceeds: Deliverables meeting customer quality expectations are provided earlier than the agreed upon schedule or under the agreed upon budget, OR deliverables exceeding customer quality expectations are provided according to the agreed upon schedule and budget.

Meets: Deliverables meeting customer quality expectations are provided according to the agreed upon schedule and budget.

Begin [R1] block addition

2.3 Sub-Task 3: [R3]~~14th~~ 15th Annual Runway Friction Workshop

The Contractor shall provide landing dynamics expert consultation services to support organizing and hosting the [R3]~~14th~~ **15th** Annual Runway Friction Workshop. Requires interaction with the Federal Aviation Administration, who is funding the event, and NASA Wallops Space Flight Center, which is the site of the event.

2.3.1 Deliverable: Workshop is conducted.

2.3.2 Required Date: [R3]~~May 14-18, 2007~~ May 12-16, 2008.

2.3.3 Performance Metrics:

Exceeds: Deliverables meeting customer quality expectations are provided earlier than the agreed upon schedule or under the agreed upon budget, OR deliverables exceeding customer quality expectations are provided according to the agreed upon schedule and budget.

Meets: Deliverables meeting customer quality expectations are provided according to the agreed upon schedule and budget.

End [R1] block addition

Begin [R2] block addition

2.4 Sub-Task 4: Port Authority (PA) Engineered Materials Arresting System (EMAS) Friction Data

NASA Langley has an agreement with the Port Authority of New York and New Jersey (PA) to provide landing dynamics expertise to support their evaluation of low maintenance materials for use in an Engineered Materials Arresting System (EMAS). PA has focused their studies on a foam glass material that is made up of glass beads bound together in a binder material whose strength can be tailored, and LaRC is providing friction measurement expertise to help them understand the foam glass material's performance as a decelerator material. An initial series of tests at Kennedy Airport has been planed for late 2007, with the potential for follow on testing in calendar year 2008 pending the results of these initial experiments.

In order to complete the initial experimental work for the PA at Kennedy Airport, NASA requires engineering services with special expertise in landing dynamics be provided by the Contractor during the following activities:

- **Pre-Test Activities:** The Contractor shall provide landing dynamics engineering expertise to work in close cooperation with the PA to plan testing activities. This planning will include defining the NASA equipment and NASA / Contractor personnel that are required to conduct the tests at each site, as well as preparing the equipment for testing. The Contractor shall participate in all NASA required safety reviews prior to deployment. The deliverables for this phase of the work shall be the Test Plan and the Test Procedure.
- **Test Activities:** The Contractor shall provide on-site landing dynamics engineering expertise at the test sites. The Contractor shall be responsible for coordinating operation of NASA equipment during the tests, and shall approve NASA equipment readiness for the required testing activities. The deliverable for this phase of the work shall be the Test Data.
- **Post-Test Activities:** The Contractor shall provide landing dynamics engineering expertise to perform data analysis for all test data collected. The deliverable for this phase of the work shall be a Test Report.

2.4.1 Milestones: The initial tests planned at Kennedy Airport are not expected to last more than one week, so intermediate milestones are not relevant. The planned testing features 8 runs on foam glass, 4 runs on foam cement, plus 2 runs on pavement. The test matrix has been designed and utilizes a Modern Design of Experiments (MDOE) approach. Approximate test dates and durations for planning purposes are provided below:

- **Kennedy Airport Tests:** 1 week, scheduled for November 13-16, 2007

2.4.2 Deliverables and Schedule:

The Contractor shall provide the following deliverables, subject to NASA review and approval:

- **Test Plan:** Text/figure document describing required tests and schedule, equipment and staffing requirements for NASA to support these tests, and planned data products. This document shall be developed in close cooperation with the PA and NASA, and will use the NASA-provided test matrix. The Test Plan shall be delivered in both electronic and hard copy forms 5 calendar days prior to first day of testing.
- **Test Procedures:** Text/figure document describing detailed activities to be performed at the test site. All testing activities that are required to produce repeatable test data shall be included in the procedure, including required equipment check-out. The Test Procedures shall be delivered in both electronic and hard copy forms 5 calendar days prior to first day of testing.
- **Test Data:** CD/DVD compilation of all test data taken by NASA along with all test run data summary sheets. All data required for independent data analysis shall be included. The Test Data shall be delivered in electronic form 1 week following the last day of testing.
- **Test Report:** A text/figure document containing: the Test Plan; an annotated copy of the Test Procedure, as executed; a tabulation or other display of all Raw Data, including complete time histories of speed, depth of tire penetration, horizontal force, vertical force and any other parameters measured; comparative charts presenting the Raw Data for the baseline, and different materials tested; and Conclusions and Recommendations for further research. The Test Report shall be delivered in both electronic and hard copy forms 4 weeks following the last day of testing. This deadline is firm.

2.4.3 Performance Metrics:

Exceeds: Deliverables meeting customer quality expectations are provided earlier than the agreed upon schedule or under the agreed upon budget, OR deliverables exceeding customer quality expectations are provided according to the agreed upon schedule and budget.

Meets: Deliverables meeting customer quality expectations are provided according to the agreed upon schedule and budget.

End R2 block addition

Begin R5 block addition

2.5 Sub-Task 5: History of Significant Research at ALDF

The Aircraft Landing Dynamics Facility at NASA Langley recently celebrated its 50th year of operation as a runway friction research laboratory. While numerous test reports and technical memoranda have been authored documenting results of individual tests and research projects conducted at the facility, there is no synthesis paper that integrates the major findings of all of this work, looks at trends in the research, and defines future areas of research based on these findings. Unfortunately, NASA has been unable to define future research requirements for this laboratory. Since there is a possibility that this laboratory may be closed, NASA would like to document the significance of the breadth of research performed at the facility over its 50+ years of operation. A comparable report was developed for the gantry shortly after plans to close

that facility were announced; this report is entitled, "A History of Full-Scale Aircraft and Rotorcraft Crash Testing and Simulation at NASA Langley Research Center." (http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20040191337_2004178862.pdf).

2.5.1 Deliverables and Schedule:

This task will commence following completion of deliverables for all other subtasks and must be completed by [R6]~~October 31, 2008~~ ***November 30, 2008***. The Contractor shall provide the following deliverables, subject to NASA review and approval:

- **Literature Search:** Comprehensive references list documenting all formal publications containing results of research performed at ALDF, and complete list of L# photographs taken of the facility(s) in operation. Due 2 weeks following task initiation.
- **Paper Outline:** Proposed organization of the synthesis paper. Due 2 weeks following Literature Search.
- **Draft Paper:** A text/figure document with references, based on NASA-approved Paper Outline. Due 1 month following Paper Outline. NASA comments to be provided within 1 week.
- **Final Paper:** A text/figure document with references, which addresses NASA feedback provided on the Draft Paper. Due 1 month following Draft Paper. To be released as a Contractor Report.

2.5.2 Performance Metrics:

Exceeds: Deliverables meeting customer quality expectations are provided earlier than the agreed upon schedule or under the agreed upon budget, OR deliverables exceeding customer quality expectations are provided according to the agreed upon schedule and budget.

Meets: Deliverables meeting customer quality expectations are provided according to the agreed upon schedule and budget.

End [R5] block addition

3. Government Furnished Items:

NASA will provide the following equipment to enable the Contractor to accomplish this work:

3.1 Grip Tester

3.2 Instrumented Tire Test Vehicle (ITTV)

3.3 Mobile Tire Test Facility (MTTF)

3.4 Computer for data analysis

4. Other Essential Information:

All required technician support for the specified Sub-Tasks will be provided by NASA.

5. Security Clearance:

None required.

6. Period of Performance:

Planned start date: [R3]April 12, 2007

Completion date:

[R2]~~December 31, 2007~~
[R3]~~March 1, 2008~~
[R4]~~May 31, 2008~~
[R5]~~July11, 2008~~
[R6]~~October 31, 2008~~
November 30, 2008

7. NASA Task Management:

[TD2]**Primary Technical Monitor:** ***Ed Fasanella***
M/S: ***495*** Phone: ***864-4345***

Alternate Technical Monitor: **Jill Marlowe**
M/S: 230 Phone: 864-7027

Other POC (Optional): **John Costulis**
M/S: 254 Phone: 864-7174

TASK ORDER NUMBER: 051D3 Revision: 0 Change: 0 Date: February 28, 2007

Title: Design and Development of Test Hardware for Airframe Noise Reduction

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 38RFF)

Provide engineering design and development of test hardware in support of Langley's Airframe Noise Reduction objectives of the Subsonic Fixed Wing Project. The specific objectives of the work to be performed under the present task are to design, develop, and perform concept evaluation of three leading edge slat structures.

Technical Direction 1 (8/13/07): Documents the extension of the period of performance 5 months to October 31, 2007 as authorized by the Contracting Officer in Mod 1, effective date 8/14/07 (see [T1] below, Section 6).
Technical Direction 2 (12/3/07): Documents the extension of the period of performance 3 months to January 31, 2008 as authorized by the Contracting Officer in Mod 2, updates the initial task order start date to April 13, 2007, and clarifies safety and organization Subtask 2.n (see [T2] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall review the findings from the first generation of concept two. The Contractor shall review the status of concept three development. The Contractor shall compare and contrast the attributes of concepts two and three and develop a "best-path-forward" strategy for meeting the project objectives. Namely, the slat-cove filler shall stow/deploy under the action of slat retraction/extention and it shall sustain simulated aerodynamic loads on the bench-top model. The Contractor shall develop final drawings for the refined concept two/three design(s). The Contractor shall oversee the fabrication of components required to demonstrate the new design(s). The Contractor shall support the evaluation of the new design(s) under representative load on the bench top.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

- Strategy for meeting project objectives based upon status of concepts two and three (03/30/2007).
- Final design and drawings for concept two/three (04/30/2007).
- Demonstration and performance evaluation of final design(s) (05/31/2007).

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: One or more final designs for concepts two and three, completed drawings, and hardware

delivery.

Exceeds: Items under Meets plus successful demonstration under representative static load on the bench top.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized [T2]***support the requirements of this task order***.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: Bench-top model, first generation of concept one, first generation of concept two, materials for fabrication of final design(s) including elastomers and superelastic SMA (shape memory alloy).

4. Other Essential Information: Designs resulting from this work are considered proprietary.

5. Security Clearance: None

6. Period of Performance:

Planned start date:	[T2]~~03/19/2007~~ ***4/13/07***	Completion date:	[T1]~~05/31/2007~~ [T2]~~10/31/07~~ ***1/31/08***

7. NASA Task Management:

Technical Monitor (Required): Travis L. Turner

M/S: 463 Phone: 757-864-3598

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 052D3-NNL07AM82T Revision: 4 Change: 0 Date: April 8, 2009

Title: STructural Analysis of General Shells (STAGS)

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 07D3K)
Research within the Structural Mechanics and Concepts Branch (SMCB) and the Durability and Damage Tolerance Branch (DDTB) at the NASA Langley Research Center requires robust nonlinear finite element technology for structural mechanics applications to study damage tolerance, durability and structural integrity of metal and non-metal aerospace structural components. Understanding the formulation aspects, the mechanics aspects and the predictive methodologies is critical to the development and application of robust (accurate, reliable and efficient) structural analysis tools to solve nonlinear mechanics problems. Currently, STAGS (or STructural Analysis of General Shells) is a primary nonlinear finite element structural analysis code used by SMCB and DDTB and their Contractors to conduct research in support of a number of NASA programs. STAGS provides advanced physics-based methods integrated with structural mechanics principles leading to computationally effective simulations – a platform for nonlinear mechanics research and an analysis tool for applications.

The work to be performed will support a number of NASA programs related to damage tolerance, durability and structural integrity requiring advanced analysis features. The work to be performed consists of a combination of engineering consulting tasks and tasks focused on developing new capabilities, implementing them within STAGS V5.0, and providing documentation for their use.

Revision 1 (5/16/07): Adds requirements to Subtask 1 and an overall LaRC site visit requirement and extends the period of performance three months to December 31, 2007 (see [R1] below).
Revision 2 (3/6/08): Adds requirements to Subtasks 1 and 2, corrects the title of Subtask 3, adds a second site visit requirement, clarifies safety and organization Subtask 2.n, reverses primary-secondary TM roles, and extends the period of performance to December 31, 2008 (see [R2] below).
Revision 3 (11/25/08): Adds requirements to Subtask 1 and extends the period of performance to December 31, 2009 (see [R3] below).
Revision 4 (4/8/09): Adds requirements as Subtask 3 (b) and Subtask 4, notes completed requirements in Subtasks 1 and 2, and updates/clarifies other requirements (see [R4] below). Note: For historical details deleted for clarity and/or convenience see previous version of this PWS located on the electronic task order system (ETOS).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 **Subtask 1: Nonlinear Mechanics Technology Development** The Contractor shall initiate nonlinear mechanics technology developments focused on:

(a) [R4]***Complete***

Begin [R1] block addition

(b) [R4]***Complete***
(c) [R4]***Complete***
(d) [R4]***Complete***

End [R1] block addition

Begin [R2] block addition

(e) Extend the PANDA/STAGS software that converts PANDA runstreams into STAGS input decks to permit multiple element units, including those with User-written Element (UEL) input. The results of this work shall allow use of a wide variety of elements in various stages of development for complex global-local buckling analyses.

End [R2] block addition
Begin [R3] block addition
(f) [R4]***Complete***
(g) [R4]***Complete***
End [R3] block addition

2.1.1 Milestones (Optional): By the end of the Task Order, deliver software. Deliver updated STAGS documentation.

2.1.2 Deliverables and Schedule (Required): (See below)

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting") (See below)

2.2 **Subtask 2: STAGS Documentation**: The Contractor shall complete the following documentation tasks:

(a) STAGS Mesher-Viewer Documentation and Example Cases. [R4]***Complete***

(b) STAGS Post-Processing Tools Documentation. The Contractor shall provide user's guides to all STAGS post-processing programs, e.g., stapl, xytrans, and pitrans. The users guides shall describe all capabilities and give explanations of the menu options. The Contractor shall work in collaboration with NASA to identify and clarify confusing menu options. All documentation shall be submitted as NASA CRs.

Begin [R2] block addition
(c) STAGS UEL Documentation. The Contractor shall provide a user guide for the GCP STAGS UEL (User Element) interface required for new UEL's developed in Subtask 1.
End [R2] block addition

2.2.1 Milestones (Optional): The Contractor shall deliver as NASA CRs STAGS V5 Mesher-Viewer user documentation including documentation of established example cases, and updated STAGS Post-Processing User's Manuals.

2.2.2 Deliverables and Schedule (Required): (See below)

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting") (See below)

2.3 **Subtask 3: STAGS [R2>]Technical Support[<R2]**: The Contractor shall perform nonlinear mechanics technology applications in collaboration with MSMB personnel and its Contractors.

(a) The Contractor shall be available for limited technical discussions and collaborative structural

modeling and analysis to support personnel at NASA LaRC as needed and with prior consent of the NASA LaRC technical monitor. The Contractor shall assist in resolution of modeling and analysis difficulties. It is anticipated that the level of effort (estimated at two days per month on average over the period of performance) shall be limited in scope unless the Statement of Work is modified. The Contractor shall install and verify STAGS operation on the NASA LaRC computers as updates are needed as well as update patches for the COTR to install in the baseline LaRC version of STAGS.

(b) R4> ***The Contractor shall assist NASA in the solution of a large, complex nonlinear analysis problem, which will serve as a focus for future STAGS enhancements as deemed necessary and approved by LaRC personnel. For planning purposes, the Contractor shall assume that this problem will involve a transient dynamic stress analysis of an Ares V vehicle. Phase 1 of this process will involve assessing the problem and determining the scope of the effort, including a preliminary assessment of STAGS capabilities. The Contractor shall work with NASA to formulate an analytical approach and conduct preliminary analyses as mutually agreed upon.*** <R4

2.3.1 Milestones (Optional): Effort expended on shall be described within the monthly report indicating the personnel involved, the nature of the technical discussion, and any modeling and/or analysis recommendations provided.

2.3.2 Deliverables and Schedule (Required): (See below)

2.3.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting") (See below)

*****Begin R4 block addition*****

2.4 **Subtask 4: STAGS Code Enhancements**: The Contractor shall modify the STAGS code to add or enhance the following capabilities:

(a) Upgrade the STAGS solution system to allow for a linear analysis the solution of multiple load cases. This capability was at one time present in STAGS, but archival and retrieval of such data was lacking. Fix any outstanding problems with the old procedure and permit users to access data not only from a current linear analysis, but also from analysis done previously for the same case, in much the same manner as is currently done for imperfection vectors.

(b) Add automatic calculation of modal participation factors and generalized masses to eigenfrequency extraction procedure. Add flag to control normalization (e.g. unit vector, mass normalized, max amplitude, etc).

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required): (See below)

2.4.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting") (See below)

End [R4] block addition*

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R2>]support the requirements of this task order.[<R2]

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

Delivery, Schedule, and Metrics – Subtasks 1-4

Deliverables

- Monthly progress reports shall identify progress made, key findings, problems and/or issues needing to be addressed by NASA, and directions for the next month.
- Monthly reports shall be submitted electronically in Microsoft Word format to the NASA Technical Monitor within five business days of the end of each month for information and approval.
- STAGS V5 documentation, including User's Manual, Element Manual, STAR Manual, and complete documentation of established "benchmark" test cases, submitted as NASA CRs.
- STAGS V5 distribution CD. The deliverable will include source code and deliverables for the [R4]~~SGI~~, Linux, and Mac OSX platforms.
- Final report shall be submitted within ten business days of the end of the contract summarizing the entire task.
- New versions of the STAGS code or modifications to the STAGS code shall be delivered (or made available) on NASA Langley computers as they are developed and shall be accessible by NASA Langley personnel. [R4>]***Each revision shall be clearly designated to distinguish it from previous revisions using a contractor specified nomenclature.***[<R4] A final version of the STAGS code shall be delivered on NASA Langley computers at the end of the period of performance. The final version deliverable will include source code and executables for the [R4]~~SGI~~ Linux, and Mac OSX platforms.
- [R1]The Contractor shall make [R2]~~one~~ two personal visits to NASA Langley to meet with POC's to discuss progress and follow-on activities.

Schedule

- The initial period of performance shall be approximately six months after contract award
- For subtasks requiring NASA review and comment, no response by NASA after ten business days shall be taken as approval of documentation provided for review.

Metrics

Meets: All requirements completed on schedule.

Exceeds: At least 50% of requirements completed ahead of schedule with rest completed on schedule.

3. Government Furnished Items:

Access to workstation computers owned and operated by the Structural Mechanics and Concepts Branch and the Durability and Damage Tolerance Branch at NASA Langley and located in Building 1148 will be provided to the Contractor.

Access to the current NASA Langley baseline version of STAGS and associated documentation will be provided.

4. Other Essential Information:

Proposed task order budget shall include labor, equipment, facilities, materials, travel and other indirect costs.

The Contractor shall ensure that its employees, in performance of the contract, receive annual information technology (IT) security training in NASA IT Security policies, procedures, computer ethics, and best practices in accordance with NPG 2810.1, Section 4.3 requirements. The Contractor may use web-based training available from NASA to meet this requirement.

All non-licensed software remains property of the Government.

5. Security Clearance:

6. Period of Performance:

Planned start date: March 15, 2007 Completion date: [R1]~~September 30, 2007~~ [R2]~~December 31, 2007~~ [R3]~~December 31, 2008~~ December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Mark Hilburger
M/S: 190 Phone: 757-864-3106

Technical Monitor (Required): Cheryl Rose
M/S: 190 Phone: 757-864-5419

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 054D3-NNL07AM84T Revision: 2 Change: 0 Date: 11-9-2007

Title: Techniques and Hardware for On-Orbit Repair of Damaged Shuttle TPS

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to develop techniques and hardware for on-orbit repair of damage incurred in the Space Shuttle thermal protection system. Damage scenarios include, but are not limited to, impact strikes to leading edge reinforced carbon-carbon (RCC) panels and acreage tiles. Impact may occur during launch or be caused on-orbit by micrometeoroid or orbital debris strikes. This task also includes processing and fabrication development of novel damage-resistant high-performance structure for next-generation aerospace vehicle systems.

Revision 1 (9-6-07): Adds processing and fabrication development of novel damage-resistant high-performance structure and updates the initial task order start date to April 24, 2007 (see [R1] above and below).
Technical Direction 1 (9/26/07): clarifies safety and organization Subtask 2.n (see [TD1] below).
Revision 2 (11/9/07): Extends the period of performance 9 months to September 30, 2008 in continuation of NASA's support with updated GFI (see [R2] below).
Technical Direction 2 (09/19/08): Documents the extension of the period of performance to October 15, 2008 as authorized by the Contracting Officer in Mod 4, dated September 18, 2008 (see [TD2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

Overall Requirements:

The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

2.1 (Requirement/subtask number one):

The Contractor shall develop techniques to repair damaged regions of the RCC leading edge and RCC nose cap and damaged regions of acreage tile regions of the Space Shuttle on a written NOC basis.
The Contractor shall develop techniques for handling and on-orbit EVA installation of the Large Area Repair (LAR) concept on the Shuttle wing leading edge and small hole repair on both the leading edge and the nose cap. [R1>]The Contractor shall develop techniques and processes for fabricating novel high-performance damage-resistant structures for advanced aerospace vehicle applications. This activity[<R1] will require the following (details will be listed in NOCs):

- Development of tools and techniques for drilling and tapping leading edge and nose cap RCC to accommodate high-temperature fasteners.
- Development of tools and techniques for capturing and installing fasteners and washer/fastener assemblies into leading edge and nose cap RCC.
- Development of tools and techniques for handling flexible ceramic composite covers and attaching the covers to damaged leading edge RCC
- Conduct of analytical and mechanical studies to assess the performance, capabilities, and limitations of the tools and techniques
- Participation in regularly scheduled repair development team meetings and teleconferences to facilitate the transfer of tools and installation techniques to NASA and Shuttle flight crew personnel
- [R1]Development of processing techniques for fabricating novel high-performance damage-resistant

structures for advanced aerospace vehicles

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Schedule will be established in the NOCs for following deliverables:

- Engineering drawings of tools
- Installation procedures documents
- [R1]Procedures for fabricating novel structures
- Engineering drawings of repair concept components
- Tools for handling and installation of repair concepts
- Written informal final report summarizing the tools, installation procedures, and [R1]processes developed.
- Additional deliverables itemized in NOCs

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

MEETS:

- Drawings meet NASA LaRC standards
- Installation procedure document describes each installation step and includes graphics/pictures to clarify steps
- Tools and hardware meet QA specifications
- Cost

EXCEEDS:

- Installation procedures document published as NASA Contractor Report
- Completion under cost
- Completion ahead of schedule

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [TD1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Contractor may use materials processing equipment located in the Light Alloy Laboratory (Building 1205) and in Polymers and Composites Laboratory (Building 1293A), [R1]the Materials Processing and Development Laboratory (Building 1267A),[R2]***and the materials processing equipment in the Structures and Materials Lab (Building 1148)***.

TASK ORDER NUMBER: 054D3-NNL07AM84T Revision: 2 Change: 0 Date: 11-9-2007

Title: Techniques and Hardware for On-Orbit Repair of Damaged Shuttle TPS

The Contractor may utilize NASA-furnished fabrication resources to complete fabrication of tools and hardware with approval from Task Technical Monitor (who will determine the availability of the fabrication resources)

The Government will furnish materials and components for the repair concepts

4. Other Essential Information:

Travel to NASA Johnson Space Center in Houston, TX, will be required. Approximately one three-day trip will be needed every two months.

5. Security Clearance: None

6. Period of Performance:

Planned start date: R1 4-24-2007 Completion date: R2 ~~12-31-2007~~

TD2 ~~9-30-2008~~

10-15-2008

7. NASA Task Management:

Technical Monitor (Required): R. Keith Bird

M/S: 188A Phone: 757-864-3512

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 055D3-NNL07AM85T Revision: 0 Change: 0 Date: March 27, 2007

Title: **NGATS ATM-Airspace Project Human Factors Issues Report**

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to review the Joint Planning and Development Office's (JPDO) Concept of Operations (ConOps), the JPDO's Operational Improvements, and results from the JPDO-sponsored human factors workshop in order to identify critical human factors issues. The results of this assessment will be documented in a written white paper report.

This task contributes to the following NGATS ATM-Airspace Project milestones:

(1) AS.1.7.01 "Develop initial system-level Con-Ops. Leverage JPDO NGATS Con-Ops, and expand development as required, to support Airspace Systems Program (Airspace & Airportal) research, and concept development" (FY07).

(2) AS.1.7.04 "Develop interim system-level concept of operations to accommodate 3x demand based on results of studies and identified gaps" (FY09).

(3) AS.4.07.01 "Develop refined system-level concept of operations based on results of modeling, safety, cost-benefits, and human-in-the-loop simulations" (FY11).

Discussions with other on-site and off-site contractors to NASA, as well as NASA civil servants, will likely be required to accomplish this task. However, all direct task guidance will come solely from the NASA Technical Monitor.

Technical Direction 1 (9/7/07): updates the schedule and period of performance to agree with the 9/6/07 extension issued by the CO (see [TD1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 The Contractor shall perform the following subtasks:

1. Review the JPDO ConOps document, the JPDO Operational Improvements document, and results from the JPDO-sponsored human factors workshop to identify critical human factors issues.
2. Initiate and engage in discussions with other on-site and off-site contractors to NASA as well as NASA civil servants, as needed, to identify and clarify the critical human factors issues related to the interests of the JPDO.
3. Describe the critical human factors issues related to the interests of the JPDO and outline potential related research opportunities in a written report.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Deliverables:

(1) Final written report identifying and clarifying the critical human factors issues related to the interests of the JPDO.

Schedule:

(a) Subtask 1 and Subtask 2 may take place simultaneously and brief informal weekly progress reports shall be provided to the NASA Technical Monitor by 4:00 p.m. Eastern Time on the last scheduled workday of each week.

(b) Draft written report shall be delivered by [TP1] ~~August 24, 2007~~ ***December 24, 2007.***
(c) **Subtask 3 shall be delivered by** [TP1] ~~**August 31, 2007**~~ ***December 31, 2007.***

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

a. Delivery of informal weekly progress reports for Subtasks 1 and 2.
   MEETS if provided weekly.
   EXCEEDS if informal progress reports are provided more often than once a week.
b. Delivery of draft written report for Subtask 3.
   MEETS if report is received by [TP1] ~~August 24, 2007~~ ***December 24, 2007.***
   EXCEEDS if report is received prior to [TP1] ~~August 24, 2007~~ ***December 24, 2007.***
c. Delivery of final written report for Subtask 3.
   MEETS if report is received by [TP1] ~~August 31, 2007~~ ***December 31, 2007.***
   EXCEEDS if report is received at least two days prior to [TP1] ~~August 31, 2007~~ ***December 31, 2007.***.

2.n Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to the extent the support required in this task order will allow.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Office space, telephone, and computer network access needed to complete the required tasks are to be provided.

4. Other Essential Information:

Contractor shall have a general level of familiarity with human factors principles and guidelines as they relate to aviation and air traffic management.

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines. The Contractor shall comply with NASA security requirements applicable to employment of foreign nationals.

6. Period of Performance:

Planned start date: As of task award Completion date: [TP1] ~~August 31, 2007~~ ***December 31, 2007.***

7. NASA Task Management:

Technical Monitors (Required):

Jennifer L. Murdoch
M/S: 156A Phone: 757-864-8304

Anthony M. Busquets
M/S: 156A Phone: 757-864-6652

TASK ORDER NUMBER: 006E4-NNL07AM86T Revision: 5 Change: 0 Date: February 23, 2009

Title: **STOL - Subsonic Fixed Wing Advanced Concepts Systems Analysis, Vehicle Design, Technology Studies, and Methods Development**

1. Purpose, Objective, or Background (Optional) (This work is separated out of TEAMS task order 002E4 [NNL07AM51T] to facilitate financial and technical tracking.)
The objective of this task is to provide advanced concepts vehicle design, 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 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 effort supports one of ASAB's main customers: the Fundamental Aeronautics Program (FAP). As part of FAP support, tools and methods development is a task priority along with the conceptual design of advanced vehicle concepts.

Revision 1 (7/9/07): Updates the initial task order start date to April 24, 2007 (issue date), updates the subtask 2.1 deliverable schedule, extends the period of performance two months to February 28, 2008, and adds requirements as new Subtask 2.2 (see [R1] below).
Revision 2 (11/29/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, adds requirements as new subtask 2.3, clarifies safety and organization Subtask 2.n, updates POC data (see [R2] below).
Technical Direction 1 (3-6-2008): Adds potential travel/training requirements and data rights clarification to Section 4 (see [TD1] below).
Revision 3 (4/23/08): Extends the period of performance 4.5 months to May 15, 2009 in continuation of NASA's support, updates GFI and subtask 2.3 schedule, adds requirements as new subtask 2.4, and adds another POC (see [R3] below).
Revision 4 (11/17/08): Extends the period of performance 3 months to August 15, 2009 in continuation of NASA's support, further updates subtask 2.3 schedule, and adds requirements as new subtask 2.5 (see [R5] below).
Revision 5 (2/23/09): Adds new item 2 to sub-task 2.3 with new deliverable, updated schedule, and renumbered items/deliverables, adds new sub-task 2.5, and extends period of performance 3.5 months to November 30, 2009 (see [R5] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The current high-lift methodology available to ASAB is significantly under performing. While the basic approach of correcting two-dimensional viscous airfoil data with a three-dimensional inviscid method is sound and has the best balance of computational speed, ease-of-use, and fidelity, the current implementation has significant issues that need to be corrected. The basic approach can be broken into two fundamentally different analyses, 1) correcting a multi-element, linear, inviscid, 3-D analysis to accurately reflect the non-linearities of the viscous behavior, and 2) generating the 2-D viscous airfoil data. It is recognized that the formulation of the inviscid method will be significantly different from traditional methods due to the special

requirement of handling the non-linearities inherent in the high-lift flight regime. The priority is to establish an improved inviscid method before addressing the viscous method.

2.1.1 The Contractor shall support the Systems Analysis, Design & Optimization (SAD&O) discipline team of the Subsonic Fixed Wing Project (SFW) in the Fundamental Aeronautics Program (FAP) by providing a non-linear, multi-element, inviscid, 3-D aerodynamic analysis that includes the following requirements:

a. Describe and evaluate the current available methodologies (UCD, VorView, VORSTAB) for strengths and weaknesses as applied to high-lift analysis. Summarize evaluation for review by ASAB personnel.
b. Identify, in consultation with ASAB personnel, the requirements to guide method development. These requirements may include, but are not limited to: flight conditions (Mach, Reynolds number), scope (type and number of: surfaces, devices, unusual configurations), interface (human, design process), and features (trim, control power, body effects, circulation modification by propulsion)
c. Develop or adapt inviscid 3-D lift method that addresses consensus requirements and code for computer execution.
d. Identify validation cases based on theory and test. Formulate a validation matrix in consultation with ASAB personnel and execute it. May be done in stages, starting with the simplest cases, proceeding to most complex cases. Test cases should range from simple, idealized, classic limiting cases through simple wings, to full jet transport configurations. Document error.
e. Benchmark the method when performing validation by tracking labor, compute, and calendar time separately.
f. Assist and train ASAB personnel in integrating method into their design process. This will require the writing of a user's manual, consulting for wrapping with model center, and aiding the modeling of a STOL RJ configuration.
g. Write a theory document that explains the methodology, its strengths, limitations, and lists references used to create it. Any references that are not readily available should be attached as an appendix.

2.1.2 The Contractor shall support the Systems Analysis, Design & Optimization (SAD&O) discipline team of the Subsonic Fixed Wing Project (SFW) in the Fundamental Aeronautics Program (FAP) by providing a viscous 2-D aerodynamic analysis capability that includes the following requirements:

a. Investigate method options for generating the 2-D viscous airfoil data. It is not anticipated that there will need to be any method development, and that choosing the best available software would suffice.
b. Identify validation cases based on theory and test. Formulate a validation matrix in consultation with ASAB personnel and execute it. May be done in stages, starting with the simplest cases, proceeding to most complex cases. Test cases should range from single element airfoils through

multiple element airfoils, to powered circulation control airfoils. Document error.

c. Benchmark the method when performing validation by tracking labor, compute, and calendar time separately.
d. Assist and train ASAB personnel in integrating method into their design process. Ensure that user manual and any additional documentation specifically pertaining to this task be made available.
e. Identify a matrix of representative airfoils and high-lift configurations for use as a generic database in consultation with ASAB personnel. The purpose of this task is to allow use of the method for design when actual airfoil data is unavailable for specific aircraft. Generate database of representative viscous airfoil data for this method.

2.1.3 Milestones (Optional):

2.1.4 Deliverables and Schedule (Required):

** Begin[R1] block update **

a. Memorandum summarizing 2.1.1a. 16 July 2007.
b. Memorandum summarizing 2.1.1b. 30 July 2007.
c. Memorandum summarizing 2.1.1c. 23 August 2007.
d. Memorandum summarizing 2.1.1d & e. 20 September 2007.
e. User's Manual of 2.1.1f in Microsoft Word format. 10 October 2007.
f. Theory Document of 2.1.1g in Microsoft Word format. 30 October 2007.
g. Memorandum summarizing 2.1.2a. 08 November 2007.
h. Memorandum summarizing 2.1.2b. 05 December 2007.
i. Memorandum summarizing 2.1.2c. 31 January 2008.
j. Memorandum summarizing 2.1.2d. 28 February 2008.
k. White Paper cataloging 2-D airfoil matrix, conditions range, and results of 2.1.2e. 01 September 2007.

** End [R1] block update **

2.1.5 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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, that is at least one week prior to specified date of delivery.

Begin [R1] block addition

2.2 (Requirement/subtask number two):

The recently released Earth Science Decadal Survey has identified polar ice thickness measurements as a high priority. Currently such measurements are made with the ICESat satellite and periodic airborne science campaigns. Using airborne assets provides a degree of flexibility and robustness not available in satellite missions. For example, ground tracks are not limited by orbital mechanics. Unlike in a satellite mission, if an instrument malfunctions it can be replaced or repaired without jeopardizing the entire mission. The harsh conditions and large area over which measurements need to be obtained for polar ice science are extremely tasking on manned aerial platforms. The use of an unmanned aerial vehicle (UAV) removes some of the safety and endurance limitations inherent with manned aircraft. The feasibility of such a mission depends highly on the ground tracks that must be flown to obtain the required ice measurements. The overall objective of this task is to obtain an estimate of the required ground tracks, the total distance that must be flown (including transit to and from an operating base), and the time required to complete the measurements given certain aircraft characteristics. The Contractor shall perform the following requirements:

- Investigate environmental conditions in Greenland and Antarctica, in particular wind speeds aloft
- Using the ICESat ground tracks as a baseline, develop a set of aircraft measurement ground tracks for Greenland and Antarctica
- Develop logic and an associated methodology for aircraft mission sortie generation which takes into account the aircraft capabilities (range and speed) and required ground tracks from above to determine individual sorties required to complete a full measurement set
- Determine the variation of number of sorties and total distance flown (including transit distances) with aircraft range capability and operating base location. Consider the following operating base scenarios:
    - Antarctica:
        - One operating base in the Falklands
        - One operating base in Tasmania
        - One operating base in New Zealand
        - Two operating bases, one in the Falklands and one in Tasmania
        - Two operating bases, one in the Falklands and one in New Zealand
        - One operating base at McMurdo Station on the Antarctic continent
    - Greenland:
        - One operating base at Thule
- Investigate alternate mission ground tracks which retain a measurement density similar to ICESat, but take advantage of the ground track flexibility offered by an airborne asset.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

Monthly status reports.
Report detailing results of the following investigations and studies:

- Wind aloft speed profiles in Greenland and Antarctica for various times of the year.
- A relevant set of aircraft measurement ground tracks for Greenland and Antarctica
- Logic and an methodology for an aircraft mission sortie generation which takes into account the aircraft capabilities (range and speed)
- The variation of number of sorties and total distance flown (including transit distances) with aircraft range capability and operating base location. The following operating base scenarios will be documented:
    - Antarctica:
        - One operating base in the Falklands
        - One operating base in Tasmania
        - One operating base in New Zealand
        - Two operating bases, one in the Falklands and one in Tasmania
        - Two operating bases, one in the Falklands and one in New Zealand
        - One operating base at McMurdo Station on the Antarctic continent
    - Greenland:
        - One operating base at Thule
- Alternate mission ground tracks for enhanced data which take advantage of the ground track flexibility offered by an airborne asset.

Report due date: September 30, 2007

2.2.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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 organization and clarity of results.

End R1 block addition

** Begin R2 block addition **

2.3 (Requirement/subtask number three):

This sub-task continues high lift research to expand the scope of the code and identify strengths and shortcomings of the MVL code. Aerodynamic predictions of the code, including the calculation of CLmax and trim, have been generated for rectangular wings of various aspect ratios, wings with elliptically varying chords, and multiple wings with good results. A new series of test cases has been identified which will address how easily the code can be modified to encompass a wider range of design problems.

It is apparent that the section aerodynamics in certain cases such as upper surface blowing are

governed by the two-dimensional input, but it is unknown how well these unusual cases can be accurately related to test data, especially in the near stall condition. It is possible that chord length adjustments might be necessary in tandem with the two dimensional aerodynamics. In addition, test cases to this point have shown that winglet geometry is properly modeled, but validation of the aerodynamic predictions for wings with winglets remains. The original scope of the code did not include winglets with dihedral >=90 degrees. This constraint eliminates application of the code to configurations such as the Stanford c-wing. A test using a complete vehicle with a real flap system must also be assessed. In order to address these new applications, the following tests shall be performed.

1. The DC-9 aerodynamics in the high lift configuration shall be modeled and existing aerodynamics test data will be compared to MVL predictions.

***** Begin [R5] block addition *****

2. Provide support for the STOL RJ system study. This requires taking provided 2D aerodynamic performance tables for highlift configurations and 3D platform information to generate 3D high lift performance tables for use in the FLOPS takeoff and landing performance analysis. This requires seven STOL RJ platforms with two highlift settings, one for takeoff and one for landing. five of these will use passive lift systems. Two of these will use active (powered) lift systems. The powered lift systems may require additional runs to cover the range of jet blowing coefficients available.

***** End [R5] block addition *****

***** Begin [R5] block renumbering *****

3. The geometry definition of MVL shall be made interoperable with the geometry definition created through Vehicle Sketch Pad (VSP).

4. A test case using winglets shall be modeled and carried out, with the results compared to configuration or wing data supplied by NASA.

5. Test cases of other unusual configurations including a box plane (swept and unswept), a Stanford C wing, a Joined Wing, a Truss Braced Wing, a canard configuration, a three surface configuration, and a conventional wing with discontinuous flap and slat deployments shall be modeled and carried out, with the results compared to configuration or wing data supplied by NASA.

6. An investigation about the need to modify (and how to modify, if necessary) the two dimensional aerodynamics for powered lift cases (Upper Surface Blowing (USB), Internally Blown Flap (IBF), Externally Blown Flap (EBF), Circulation Control Flap (CCF), and Synthetic Jet augmented plain flap) shall be conducted.

***** End [R5] block renumbering *****

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

1. **Deliverable due:** A report that contains the tabular data collected and generated as well as compared in plot form, input and output cases for MVL, and a narrative describing the process and interpreting the results.
Due date: R3~~05/01/08~~ R4~~10/15/08~~ 01/15/09.

Begin R5 block addition

2. **Deliverable due:** A report that contains the tabular data collected and generated as well as compared in plot form, input and output cases for MVL, and a narrative describing the process and interpreting the results. (STOL RJ system study)
Due date: 03/13/09.

End R block addition

*** Begin R5 block renumbering ***

3. **Deliverable due:** A demonstration of a set of multi-section-wings being exchanged from VSP to MVL in a general and robust fashion.
Due date: R3~~07/01/08~~ R4~~12/15/08~~ R5~~03/15/09~~ ***04/15/09***.

4. **Deliverable due:** A memorandum that contains the tabular data supplied and generated as well as compared in plot form, input and output cases for MVL, and a narrative describing the process and interpreting the results.
Due date: R3~~09/01/08~~ R4~~02/15/09~~ R5~~05/15/09~~ ***06/15/09***.

5. **Deliverable due:** A memorandum that contains the tabular data supplied and generated as well as compared in plot form, input and output cases for MVL, and a narrative describing the process and interpreting the results.
Due date: R3~~11/01/08~~ R4~~03/15/09~~ R5~~06/15/09~~ ***07/15/09***.

6. **Deliverable due:** A memorandum that contains a summary explaining the preferred method of implementing powered lift and the efficacy of that method for each of the powered lift types enumerated.
Due date: R3~~12/31/08~~ R4~~05/15/09~~ 08/15/09.

*** End R5 block renumbering ***

2.3.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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 organization and clarity of results.

** End R2 block addition **

** Begin [R3] block addition **

2.4 (Requirement/subtask number two):

The DARPA Vulture program aims to achieve 99% on-station availability over the five-year mission duration. A credible estimate for on-station availability for solar powered aircraft must account for large number of coupled variables. These include wind velocity, orbit pattern, sensor capabilities, vehicle cruise speed, energy balance, and solar latitude. NASA's High Altitude Long Endurance (HALE) Analysis of Alternatives study and the Vulture bidders pre-proposal studies used simplifying assumptions to reduce the complexity of the problem. Although these assumptions varied among the studies, in general the wind data was averaged over long periods of time and the wind direction was assumed to be compatible with the required orbit and optimum solar collection positioning. Design cruise speeds were set by the average 99th percentile wind speed, not 99% on-station capability requirements, which could result in over-designed vehicle. Conversely, solar collection was simulated without accounting for loaded wing shape, required orbit pattern, array shading, sun angle, and so on. These assumptions could result in an under-designed vehicle.

Technical Tasks - On-station availability analysis

In order to develop a simulation capability to provide credible estimates for on-station capability of the Vulture concepts, NASA Langley Research Center will accomplish the following:

1. In conjunction with the DARPA customer, define the problem and formulate an approach to solving it.
2. Identify existing modules and analysis components that can serve as building blocks for the simulation model.
3. Identify modeling gaps and develop new tools and methods to fill those gaps.
4. Integrate the process model. Validate and verify the performance of the model
5. Develop simulations of three Vulture concepts and analyze their on-station availability.

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required):

1. **Deliverable due:** Two briefings provided to both NASA and DARPA – the first will be initial results **(8/31/08)** and second will be final results **(11/15/08)**. Final briefing should include estimates of the on-station capability for the Vulture concepts.
2. **Deliverable due:** In conjunction with the NASA and DARPA customers, define the problem and formulate an approach to solving it.
   Due Date: 05/31/2008.
3. **Deliverable due:** Identify existing modules and analysis components that can serve as building blocks for the simulation model. Identify modeling gaps and develop new tools and methods to fill those gaps.
   Due Date: 06/30/2008.
4. **Deliverable due:** Integrate the process model. Validate and verify the performance of the

model. Develop simulations of four Vulture concepts and analyze their on-station availability. Initial results/status briefing due 8/31/08.
Due Date: 11/15/2008.

5. **Deliverable due:** Final results due 11/15/08.

Travel – Plan for three trips to Washington, D.C. One night stay.

2.4.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets Minimum Performance: Deliverables as described and on time.

Exceeding Minimum Performance: Deliverables on time, plus added value in terms of briefing/report quality, cohesive collaborative effort, modeling success, or initiative shown in organization and clarity of results.

** End R3 block addition **

** Begin R4 block addition **

2.5 (Requirement/subtask number two):

The DARPA Vulture project aims to achieve 99% on-station availability over the five-year mission duration. Currently, three contractors (Aurora Flight Sciences, Boeing and Lockheed Martin) are executing Phase I efforts. A down select to one contractor is anticipated prior to entry into Phase II in early spring 2009. Independent technical assessment of the contractor's Phase I Objective System concepts performance related to the 99% probability of station keeping goal is required to support the down select decision.

Technical Tasks - On-station availability analysis

Probability of station keeping analysis

In order to provide credible estimates for probability of station-keeping of the Vulture concepts, NASA Langley Research Center will accomplish the following:

1. Develop any required enhancements to the analysis and simulation tools that were created during the previous effort
2. Update the input assumptions to match both the PMR-2 concepts, and the input parameters resulting from the government assessment.
3. Continue to update the models as additional concept data is obtained.
4. Produce one PDM (Project Data Memo) for each of the three concepts summarizing the analysis methodology and results.

***** Begin R5 block addition *****

5. Work with NASA atmospheric science POC (Garry Qualls) to obtain NCEP data suitable for direct comparison to NCDC based results.

6. Run probability of station keeping analysis (including energy balance) utilizing NCEP data.
7. Produce comparison report and recommend approach for Phase II analysis based on results.

***** End [R5] block addition *****

2.5.2 Deliverables and Schedule (Required):

Two briefings provided to both NASA and DARPA – the first will be the final results of task 2, due 12/15/08 (initial results are due under the previous task on 11/17/08), and second will be final results of task 3, due 2/2/09. Accompanying PDMs (one for each concept) are due 2/2/09 as well.

***** Begin [R5] block addition *****

Task 5, 6, 7 briefings provided to NASA on results due 10/31/09.

***** End [R5] block addition *****

Schedule

11/18/08 – 12/15/08 : Perform task 1 and 2, provide briefing on initial results 12/15/08.

12/15/08 – 2/2/09: Perform task 3 and 4, provide briefing and PDMs on final results 2/2/09.

***** Begin [R5] block addition *****

4/1/09 – 11/30/09: Perform task 5, 6, and 7 and provide final briefing on 10/31/09 (note – this will not be a full-time effort)

***** End [R5] block addition *****

Travel – Plan for three trips to Washington, D.C. One night stay.

2.5.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets Minimum Performance: Deliverables as described and on time.

Exceeding Minimum Performance: Deliverables on time, plus added value in terms of briefing/report quality, cohesive collaborative effort, modeling success, or initiative shown in organization and clarity of results.

** End [R4] block addition **

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R2]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

A. Existing specialized analysis, processing, and/or design tools
B. Existing models, databases, geometry, data descriptions, and/or test data
C. Computer workstations and CPU time

** Begin [R3] block addition **

D. Data on Vulture concepts will be provided to support modeling task
E. STK and ModelCenter software will be provided.

** End [R3] block addition **

4. Other Essential Information:

** Begin [TD1] block clarification**

The Contractor shall participate in appropriate technical conferences/short courses to maintain cognizance of new approaches and to refresh skills, as needed, to support the requirements of this task order as coordinated with the Technical Monitor.

NOTE: The Contractor shall place no restrictions on NASA's use or distribution of the models and/or codes produced under this task order. The models and/or codes shall only be used for performing the work under this contract and cannot be used for any other purpose nor distributed without the permission of NASA, Langley. The Contractor is required to sign a Software Usage Agreement.

** End [TD1] block clarification **

5. Security Clearance:

6. Period of Performance:

Planned start date: [R1]April 24, 2007

Completion date: [R1]~~December 31, 2007~~
[R2]~~February 28, 2008~~
[R3]~~December 31, 2008~~
[R4]~~May 15, 2009~~
[R5]~~August 15, 2009~~
November 30, 2009

7. NASA Task Management:

Technical Monitor (Required): Jeffrey K. Viken
M/S: 442 Phone: 757-864-2875

Other POC (Optional): [R2]**Andrew Hahn**
M/S: 442 Phone: 757-864-**1170**

Other POC (Optional): [R3]**Craig Nickol**
M/S: 442 Phone: 757-864-8398

TASK ORDER NUMBER: 007E4-NNL07AM87T Revision: 3 Change: 0 Date: February 23, 2009

Title: **Benchmarking BWB - Subsonic Fixed Wing Advanced Concepts Systems Analysis, Vehicle Design, Technology Studies, and Methods Development**

1. Purpose, Objective, or Background (Optional)

(This work is separated out of TEAMS task order 002E4 [NNL07AM51T] to facilitate financial and technical tracking.) The objective of this task is to provide advanced concepts vehicle design, 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 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 effort supports one of ASAB's main customers: the Fundamental Aeronautics Program (FAP). As part of FAP support, tools and methods development is a task priority along with the conceptual design of advanced vehicle concepts.

Revision 1 (12-7-2007): Adds requirements as a new subtask 2.2, extends the period of performance 10 months to December 31, 2008, updates the initial task order start date to April 24, 2007, and clarifies safety and organization Subtask 2.n (see [R1] below).
Technical Direction 1 (3-8-2008): Adds potential travel/training requirements and data rights clarification to Section 4 and adds the code *ModelCenter* to task 2.2-1-e (see [TD1] below).
Revision 2 (11/14/08): Adds requirements as a new subtask 2.3, extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support, and updates task management data (see [R2] below).
Revision 3 (02/23/09): Adds requirements to subtask 2.3 and updates 2.3.2 deliverables schedule (see [R3] below).

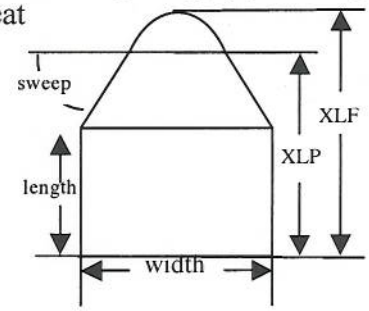
2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The contractor shall support the Systems Analysis, Design & Optimization (SAD&O) discipline team of the Subsonic Fixed Wing Project (SFW) in the Fundamental Aeronautics Program (FAP) as follows:

a) Provide formal documentation of the history of development and validation of the Flight Optimization System (FLOPS). The documentation will include reference sources and results for the validation of the individual modules of FLOPS. This activity will require interaction with the ASAB SFW Tool Benchmarking Lead for determining the proper form and requirements for formal documentation.
b) Provide tool benchmarking analysis calculating error for the individual modules of FLOPS using the most current data available. This will include, but is not limited to, 737-800 cruise and low speed data and 757-200 weight breakdown summary. This activity will follow the guidelines set forth for the overall Fundamental Aeronautics Program-Subsonic Fixed Wing Project-Systems Analysis, Design, and Optimization Discipline Tool Benchmarking Task.

c) Integrate a method to size the passenger compartment of a BWB (blended wing body) type concept into FLOPS. Given the leading edge sweep, number of passengers, seat pitches for tri-class seating, fuselage height and any of the following input, FLOPS shall be capable of calculating the length and width of the passenger compartment. Sizing shall include appropriate area for galleys and lavatories for the number of passengers.



- length / width ratio
- length
- width

d) Conduct a literature search and investigate alternatives for predicting wing and centerbody (passenger compartment) structural weight. These alternatives shall include the existing capabilities in FLOPS (detailed and empirical), the structural weight capability of the Boeing's WingMOD, Equivalent Laminated Plate Solution (ELAPS) computer code, and PDARB, if the codes are available. The contractor shall report on the results of his or her findings, including an overview of the required input and output and cost of each option. Based on the results of the survey, the contractor and NASA will select the 3 best options based on capability, accuracy, ease of use, and interoperability with other NASA codes (FLOPS, AWAVE, VORLAX, VSP, etc). Each option shall be applied to at least 2 mutually agreed upon aircraft concepts where known data is available and 1 unconventional BWB concepts.

- WingMOD is an MDO code that optimizes aircraft wings and horizontal tails subject to an array of constraints.
- ELAPS is a NASA developed design oriented structural analysis method which is intended for use in the early design of aircraft wing structures
- PDARB is a NASA Ames developed stiffened shell with buckling criteria code that specifically handles non-circular, pressurized fuselages. It has been integrated into the hypersonic vehicle synthesis code HAVOC, and would need to be split out and wrapped before being evaluated.

e) Select with NASA the best alternative for further evaluation and integrate it into ModelCenter, a visual environment for process integration.

f) Perform a multidisciplinary analysis of at least 3 mutually agreed upon subsonic aircraft concepts where known data is available, 1 supersonic aircraft (Concorde), and 2 unconventional concepts including the NASA provided 450-passenger Blended Wing Body (BWB) BWB450–1U. The purpose of this subtask is to further calibrate the new capability and demonstrate the overall process developed in subtask 2.1c).

g) Maintenance and improvement in the Flight Optimization System (FLOPS) including updating user's manuals documenting any modifications.

h) Detailed external geometry and internal structural arrangement for advanced concepts (i.e., hybrid wing, next generation single-aisle transport) using Pro-E or similar CAD package. This activity will require interaction with the ASAB SFW Advanced Concepts lead on an as needed basis.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

1) Formal report detailing the history of development and validation of FLOPS as per the guidance of

the ASAB SFW Tool Benchmarking Lead (9/30/07).

2) Informal Oral Presentation (6/30/07) and Formal report detailing the tool benchmarking analysis calculating error for the individual modules of FLOPS using currently available data. Report format will adhere to the guidelines supplied by the ASAB SFW Tool Benchmarking Lead (9/30/07).

3) Working version of FLOPS capable of sizing the passenger compartment for BWB type concepts (9/30/07).

4) Report on available structural analysis options meeting the requirements of this task and lessons learned and results from the 3 selected options (12/31/07).

5) Integrated process for wing and fuselage structural analysis and weight prediction (02/28/08).

6) Report detailing analysis and "real" data and an updated/calibrated "process" (02/28/08).

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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. This includes briefings of results to Aviation Safety Program, Airspace Systems Program and JPDO colleagues. 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).

** Begin[R1] block addition**

2.2 (Requirement/subtask number two):

1) The Contractor shall support the Systems Analysis, Design & Optimization (SAD&O) discipline team of the Subsonic Fixed Wing Project (SFW) in the Fundamental Aeronautics Program (FAP) as follows:

a) Conduct a literature search and investigate alternatives for predicting wing and centerbody (passenger compartment) structural weight. These alternatives shall include the existing capabilities in FLOPS (detailed and empirical), the structural weight capability of the Boeing's WingMOD, Equivalent Laminated Plate Solution (ELAPS) computer code, and PDARB, if the codes are available. The Contractor shall report on the results of his or her findings, including an overview of the required input and output and cost of each option. Based on the results of the survey, the Contractor and NASA will select the 3 best options based on capability, accuracy, ease of use, and interoperability

with other NASA codes (FLOPS, AWAVE, VORLAX, VSP, etc). Each option shall be applied to at least 2 mutually agreed upon aircraft concepts where known data is available and 1 unconventional BWB concepts.

- WingMOD is an MDO code that optimizes aircraft wings and horizontal tails subject to an array of constraints.
- ELAPS is a NASA developed design oriented structural analysis method which is intended for use in the early design of aircraft wing structures
- PDARB is a NASA Ames developed stiffened shell with buckling criteria code that specifically handles non-circular, pressurized fuselages. It has been integrated into the hypersonic vehicle synthesis code HAVOC, and would need to be split out and wrapped before being evaluated.

b) Coordinate the activities above with the ongoing hybrid-wing body structural weight estimation work being conducted by AVID Technology under an NRA with the FAP-SFW Project. The contractor and NASA will select the best alternative for further evaluation and integrate it into ModelCenter (or whatever Gen 1 or Gen 2 modeling environment is selected by NASA to use instead of ModelCenter), a visual environment for process integration.

c) Develop and integrate a method to size the outboard wing panel of a Blended-Wing-Body (BWB) type concept into FLOPS. Given the geometry of a BWB fuselage, particularly at the side-of-body/wing root intersection, and any other geometric constraints, optimize the geometry of the outboard wing panel for overall aircraft objectives.

d) Perform a multidisciplinary analysis of the NASA provided 450-passenger Blended Wing Body (BWB) BWB450–1U. The purpose of this subtask is to further calibrate the new capability and demonstrate the overall process developed in subtask "c".

e) Support the FAP-SFW Systems Analysis, Design & Optimization Discipline by performing a GEN 1 toolset validation exercise. This analysis will include modeling a Boeing 787 type subsonic transport in FLOPS/<TD1>ModelCenter environment<TD1 using publicly available data and an engine deck provided by NASA GRC, validating the model versus published range/payload data (when it becomes available), and assisting the NASA team in compiling a report documenting the GEN 1 toolset validation.

f) Develop and integrate a method to size horizontal and vertical tails for a subsonic transport into FLOPS. A data base of existing aircraft characteristics will be generated. Based on this data base and stability and control principles, a methodology will be developed to estimate the required size for horizontal and vertical tails.

g) Conduct a literature search and investigate alternatives for a methodology to estimate low speed aerodynamic drag polars for a subsonic transport that can be integrated into FLOPS. If methods are found that are compatible with the level of information available in FLOPS, the contractor and NASA will select the best alternative for further evaluation and integration. It may be integrated into FLOPS itself or into ModelCenter, a visual environment for process integration. If a suitable methodology is not found, the contractor will develop a rudimentary capability to estimate the required polars using parametric data already present in FLOPS.

h) Modify the wave drag estimation code Awave to provide the capability for more cuts along the x-axis. Investigate the irregular convergence with increasing numbers of x-cuts, find the problem, and correct it.

i) Maintain and improve the Flight Optimization System (FLOPS) adding minor options requested by customers and correcting any problems. This will include updating user's manuals and online documentation for any modifications. Current requests include (coordinate with ASAB Mark

Guynn); 1) Modify analysis approach in FLOPS to break current link between fuel consumption and aircraft weight. That is, the current code assumes that as fuel (energy) is used, the weight decreases, which is not the case for something like a battery powered vehicle or some other more exotic propulsion options, 2) Add taxi, takeoff, approach, landing emissions to total emissions calculation, 3) Add new mission segment type: constant altitude cruise/step climb (as opposed to current cruise climb), in which FLOPS would automatically determine optimum starting altitude and at would point it is best to climb to the next altitude level, 4) Determine how ETOPS requirements affect design and sizing. Add mission segment/analysis to assess ETOPS capabilities/constraints. (Continuing)

j) Maintain and improve aerodynamic analysis codes (Wing Design, Aero2s, Awave, etc.) adding minor options requested by customers and correcting any problems. This will include updating user's manuals and online documentation for any modifications. (Continuing)

k) Provide support to internal and external projects using the supported codes on an as needed basis. This support may include advice, tutoring, troubleshooting, critique, and analysis. (Continuing)

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

1) Informal oral and written report on available structural analysis options meeting the requirements of this task, lessons learned and options for integrating AVID Technology SFW NRA results. (1/31/08)

2) Deliver modified Awave drag estimation code capable of additional x-axis cuts. (4/30/08).

3) Deliver working version of FLOPS capable of sizing/optimizing the passenger compartment and outboard wing panel for BWB type concepts. Validate by modeling task "d" concept. (6/30/08)

4) Formal report documenting FLOPS GEN-1 toolset validation exercise involving modeling Boeing 787 configuration, comparison of payload/range performance, and mutually agreed upon (contractor and SAD&O team) validation exercises. (9/30/08)

5) Deliver working version of FLOPS with integrated new tail sizing methodology. (10/31/08)

6) Informal report and working version of FLOPS with integrated low-speed polar prediction process as detailed in task "g". (12/31/08)

7) Formal report and working version of FLOPS (integrated into ModelCenter if appropriate) for new wing and fuselage structural analysis and weight prediction resulting from the work of tasks "a" and "b". (12/31/08)

2.2.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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. This includes briefings of results to Aviation Safety Program, Airspace Systems Program and JPDO colleagues. 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).

** End [R1] block addition **
** Begin[R2] block addition**

2.3 (Requirement/subtask number three):

1) The contractor shall support the Systems Analysis, Design & Optimization (SAD&O) discipline team of the Subsonic Fixed Wing Project (SFW) in the Fundamental Aeronautics Program (FAP) by providing:

a) Develop and integrate a method to size the outboard wing panel of a Blended-Wing-Body (BWB) type concept into FLOPS. Given the geometry of a BWB fuselage, particularly at the side-of-body/wing root intersection, and any other geometric constraints, optimize the geometry of the outboard wing panel for overall aircraft objectives. The contractor shall coordinate this effort with NASA LaRC Craig Nickol. (Continuing)
b) The contractor shall implement a new FLOPS capability to accommodate at least one other engine type, or alternate engine performance of a multimode engine, in an airplane performance simulation. The user will have the ability to switch between the primary and auxiliary engine(s) for any flight segment. Consideration must be given to potential research questions such as: What if the engines use different fuel types? What if the other engine uses no fuel (electric)? What if you want to use multiple engine types at the same time at the same time rather than switching between them? How does the auxiliary engine affect weight and aero? What about sizing bookkeeping? The contractor shall coordinate this effort with NASA GRC Jeff Berton and NASA LaRC Karl Geiselhart and Andy Hahn.
c) The contractor shall implement a new FLOPS capability to perform time-step calculations of the approach/landing flight path between and altitude of 100ft and the user-specified start-of-approach altitude, using a user-specified time interval. (Currently FLOPS only does a calculation at the start of approach altitude and then skips forward to 95 ft). The contractor shall coordinate this effort with NASA LaRC Erik Olson.
d) The contractor shall implement a new FLOPS capability to output the landing flight path to an external file in the same format as the takeoff flight profile. (This currently requires an external utility). The contractor shall coordinate this effort with NASA LaRC Erik Olson.
e) The contractor shall implement a new FLOPS capability to alter the takeoff noise profile module to add the option to climb at fixed thrust and a user-specified fixed fraction (<=1) of

the available climb rate. This capability provides an acceleration segment which is more stable and doesn't require the user to tweak the flight path angle, angle of attack or cabin floor angle to find the one that balances climb and acceleration. The contractor shall coordinate this effort with NASA LaRC Erik Olson.

f) The contractor shall implement a new FLOPS capability to add new mission segment type: constant altitude cruise/step climb (as opposed to current cruise climb), in which FLOPS would automatically determine optimum starting altitude and at would point it is best to climb to the next altitude level. The cruise altitudes should be separated by 2000 ft up to 29000 ft, and by 4000 ft above 29000 ft (This would be consistent with current assigned flight levels). The contractor shall coordinate this effort with NASA LaRC Erik Olson and Mark Guynn.

g) Develop and integrate a method to size horizontal and vertical tails for a subsonic transport into FLOPS. A data base of existing aircraft characteristics will be generated. Based on this data base and stability and control principles, a methodology will be developed to estimate the required size for horizontal and vertical tails. (Continuing)

h) Conduct a literature search and investigate alternatives for a methodology to estimate low speed aerodynamic drag polars for a subsonic transport that can be integrated into FLOPS. If methods are found that are compatible with the level of information available in FLOPS, the contractor and NASA will select the best alternative for further evaluation and integration. It may be integrated into FLOPS itself or into ModelCenter, a visual environment for process integration. If a suitable methodology is not found, the contractor will develop a rudimentary capability to estimate the required polars using parametric data already present in FLOPS. The contractor shall coordinate this effort with NASA LaRC Andy Hahn.

i) Maintain and improve the Flight Optimization System (FLOPS) adding minor options requested by customers and correcting any problems. This will include updating user's manuals and online documentation for any modifications. Current requests include (coordinate with ASAB Mark Guynn); 1) Modify analysis approach in FLOPS to break current link between fuel consumption and aircraft weight. That is, the current code assumes that as fuel (energy) is used, the weight decreases, which is not the case for something like a battery powered vehicle or some other more exotic propulsion options, 2) Add taxi, takeoff, approach, landing emissions to total emissions calculation, 3) Add new mission segment type: constant altitude cruise/step climb (as opposed to current cruise climb), in which FLOPS would automatically determine optimum starting altitude and at would point it is best to climb to the next altitude level, 4) Determine how ETOPS requirements affect design and sizing. Add mission segment/analysis to assess ETOPS capabilities/constraints. (Continuing)

j) Maintain and improve aerodynamic analysis codes (Wing Design, Aero2s, Awave, etc.) adding minor options requested by customers and correcting any problems. This will include updating user's manuals and online documentation for any modifications. (Continuing)

k) Provide support to internal and external projects using the supported codes on an as needed basis. This support may include advice, tutoring, troubleshooting, critique, and analysis. (Continuing)

***** Begin[R3] block addition*****

l) Provide support for the STOL RJ system study. This requires defining eight FLOPS models, seven of which use NPSS engine models. Particular emphasis will be given to performance in the takeoff and landing phases of flight. This can be considered a specific and high-priority subtask of k. The Contractor shall coordinate this effort with NASA LaRC Andy Hahn.

***** End [R3] block addition *****

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

1) Perform Task 2.3 a); provide documentation and informal briefing/tutorial on progress to-date. (1/31/09)
2) Perform Task 2.3 c)d)e)f); provide documentation and informal briefing/tutorial on completed capability in FLOPS. ([R3>]~~3/31/09~~ ***05/12/09***)
3) Perform Task 2.3 g); provide documentation and informal briefing/tutorial on completed/validated capability in FLOPS. ([R3>]~~5/31/09~~ ***07/12/09***)
4) Perform Task 2.3 b); provide documentation and informal briefing/tutorial on completed/validated capability in FLOPS. ([R3>]~~9/30/09~~ ***11/12/09***)
5) Perform Task 2.3 h); provide documentation and informal briefing/tutorial on progress to-date. (12/31/09)

***** Begin[R3] block addition*****

6) Perform Task 2.3 l); Provide eight FLOPS models of STOL RJs. (03/20/09)

***** End [R3] block addition *****

2.3.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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. This includes briefings of results to Aviation Safety Program, Airspace Systems Program and JPDO colleagues. 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).

** End [R2] block addition **

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management

walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

A. Existing specialized analysis, processing, and/or design tools
B. Existing models, databases, geometry, data descriptions, and/or test data
C. Computer workstations and CPU time

4. Other Essential Information:

** Begin [TD1] block clarification**

The Contractor shall participate in appropriate technical conferences/short courses to maintain cognizance of new approaches and to refresh skills, as needed, to support the requirements of this task order as coordinated with the Technical Monitor.

NOTE: The Contractor shall place no restrictions on NASA's use or distribution of the models and/or codes produced under this task order. The models and/or codes shall only be used for performing the work under this contract and cannot be used for any other purpose nor distributed without the permission of NASA, Langley. The Contractor is required to sign a Software Usage Agreement.

** End [TD1] block clarification**

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: [R1]April 24, 2007

Completion date: [R1]~~February 28, 2008~~ [R2]~~December 31, 2008~~ December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Jeffrey K. Viken
M/S: 442 Phone: 757-864-2875

[R2]**Other POC (Optional): Phil Arcara**
M/S: 442 Phone: 757-864-5978

1. Purpose, Objective, or Background (Optional) (This work is separated out of TEAMS task order 002E4 [NNL07AM51T] to facilitate financial and technical tracking.)
The objective of this task is to provide advanced concepts vehicle design, 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 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. This effort supports one of ASAB's main customers: the Fundamental Aeronautics Program (FAP).

Revision 1 (05/22/2007): Adds requirements as a new subtask in section 2.2 and for anticipated travel, updates subtask 1 schedule, and extends the period of performance three months to March 31, 2008 (see [R1] below).

Revision 2 (11/29/2007): Adds requirements as a new subtasks in sections 2.1 and 2.3, extends the period of performance nine months to December 31, 2008, updates Subtasks 2.1 and 2.2 schedules, clarifies safety and organization Subtask 2.n, updates the initial task order start date to April 24, 2007, and updates POC data (see [R2] below).

Revision 3 (05/28/2008): Adds new subtasks with deliverables in sections 2.1 and 2.2 and extends the period of performance one year to December 31, 2009, removes some existing requirements from section 2.2, and replaces Alternate POC (see [R3] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Subtask 1:
These tasks are in support of the Supersonics (SUP) Program in the Fundamental Aeronautics Program.

a) The Contractor shall conduct a study of how aerodynamic efficiency is affected when trying to meet performance constraints such as weight or range in low boom conceptual design. This study shall also include how numerical noise in the second derivates slope of total equivalent area affects the far-field sonic boom signature of low boom configurations.

b) The Contractor shall develop a method for incorporating nozzle plume shapes into the low boom design process using supplied plume shapes.

c) The Contractor shall develop methodology for incorporating shaping of the configuration to impact the aft portion of the sonic boom signature of low boom configurations.

d) The Contractor shall calibrate low boom design methods with test data supplied from SUP project flight test results. Supplied data will include plume shock measurements as well as tail lift shock

data.

Begin [R2] block addition

e) The Contractor shall test improved version of BOSS with Arbitrary fuselage cross-section capability for low boom vehicle design.

f) The Contractor shall evaluate newly developed target F-functions capability for practical low boom configurations. The Contractor shall evaluate the feasibility of interactively defining these target F-functions during the design process and provide feedback for further development needs.

End [R2] block addition

*****Begin [R3] block addition*****

g) The Contractor shall develop a design of an N+2 technology level, low boom supersonic vehicle. The N+2 requirements are currently being developed under another contract and will be delivered to the Contractor on June 6th, 2008. The Contractor shall use these requirements as a basis for the design. The requirements shall include sonic boom levels, payload, range and noise acceptability limits. The Contractor shall build up the concept model within the ModelCenter framework and include all available and required analysis modules for this study so that trade studies can be quickly performed on the concept. The Contractor shall include design features present in the Supersonic icon vehicle including integrated nose spike and a highly integrated propulsion system.

h) The Contractor shall continue to test new capabilities developed for use in Supersonic Low Sonic Boom design and analysis. The new capabilities will be provided on an as available basis but shall include automated CFD capabilities, improved ModelCenter modules, new or improved geometry modeling capabilities, and automated rapid structural analysis methods. The Contractor shall test new capabilities and provide feedback on their ease of use, ability to be quickly integrated and overall enhancement to the Supersonic design and/or analysis process.

*****End [R3] block addition*****

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (correspond to above tasks):

a) Memo documenting the results of efficiency/performance constraints study and shape smoothness effects. Due by: May 31, 2007

b) Incorporation of plume shapes into the low-boom design process demonstrated.
Due by: October 31, 2007

c) Incorporation of aft signature shaping into the low-boom design process demonstrated.
Due by: [R2]~~December 31, 2007~~ April 30, 2008

d) Boom design methodology for plume and aft end calibrated using test data.

Due by: R2R1~~March 31, 2008~~ July 31, 2008

(This task is dependent on timely availability of supplied Flight Test data)

*****Begin R3 block addition*****

e) Provide interim oral feedback and final memo describing evaluation of arbitrary fuselage capability and usage guidelines. Due by: July 31, 2008

f) Provide interim oral feedback and final memo describing evaluation of new target F-function capability and usage guidelines. Due by: December 31, 2008

g) The Contractor shall deliver a quarterly status report in Powerpoint format describing the stage of concept development, design issues and method shortcomings.
Due by: September 30, 2008; December 31, 2008

h) The Contractor shall provide a final report in PowerPoint format describing the final N+2 concept. The Contractor shall also provide the accompanying complete ModelCenter model for the concept. Due by: March 31, 2009

i) The Contractor shall provide interim oral feedback and quarterly PowerPoint documentation on evaluation of new or improved capabilities. The feedback shall cover capabilities evaluated and feedback on increased speed, improved analysis capability and any additional relevant information that could be used to assess future development needs. A final summary document will compile all of this feedback into one PowerPoint presentation to be presented to the SIAV supersonics team. Due by: Ongoing. Final document due December 31, 2009

*****End R3 block addition*****

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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).

Begin R1 block addition

2.2 Subtask 2:

These tasks are in support of the Supersonics (SUP) Program in the Fundamental Aeronautics Program.

a) The Contractor shall modify the PBOOM sonic Boom prediction code to enable the inclusion of lift pressure distributions from USM3D. The Contractor shall also modify the mach slicing areas to better reflect the actual geometry being evaluated. The modifications should be compatible with the ModelCenter implementation of the Supersonics design system. The PBOOM code is a collection of integrated analysis modules which shall be separated and re-integrated within the ModelCenter environment to allow for the choice of lift pressure and geometry used for input.

b) The Contractor shall become familiar with the Vehicle Sketch Pad (VSP) geometry tool source code. The Contractor shall make modifications to the software to enable direct output of the geometry into the Craidon geometry format. The Contractor shall improve the current VSP ModelCenter Plugin to improve current functionality and incorporate the recent internal arrangement capability into the Plugin. The Contractor shall develop an installer package for the Plugin for both ModelCenter and ModelRunner.

*****Begin [R3] block addition** Replaces previous requirements c) and d)***

c) The Contractor shall participate in the VSP user/developers group and shall act as the version control POC for developments of the team. The Contractor shall use software best practices for rewriting each code to bring them up to standards. The Contractor shall convert identified FORTRAN codes to C++ (or comparable language). The Contractor shall make necessary adjustments to ModelCenter wrappers for each migrated code the Subversion software for version control. The Contractor shall participate in VSP user/developer group meetings which are scheduled on an as needed basis. The Contractor shall compile modification requests and development by other members. The Contractor shall submit these requests to the NASA team in ASAB for final decision on inclusion in the official NASA version of VSP.

d) The Contractor shall aide the supersonics design team in ASAB in developing a strategy for a long term geometry approach that best tasks advantage of needs and available software. The Contractor shall develop an understanding of the current developments going in within the Supersonics project and other Fundamental Aeronautics projects related to geometry applications and the analysis methods that will use this geometry. These will include such software packages such as but not limited to VSP, CDM & ProE as well as geometry manipulation tools such as but not limited to CAPRI, GMAP, and similar tools.

e) The Contractor shall implement the agreed upon strategy through modifcations to exisiting geometry software or develop the required interfaces for commercial products. The strategy will be developed for a phased implementation corresponding to task milestones. The task will be updated upon completion of the strategy document.

*****End [R3] block addition*****

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (correspond to above tasks):

a) Successful demonstration of integrated modified PBOOM capability in ModelCenter with multiple options for Mach slicing area distributions and Lift pressure distributions. Due by: [R2]~~September 30, 2007~~ [R3]~~April 30, 2008~~ ***September 30, 2008***

b) Successful demonstration of ability to output Craidon format geometry from VSP: July 31, 2007

*****Begin [R3] block addition** Replaces previous requirements c), d), and e)***

c) The Contractor shall maintain the version control system for VSP
Due Date: Ongoing as updates are received

d) The Contractor shall submit a document outlining the long term proposed strategic approach to geometry capabilities for the Supersonics team. The document shall incorporate an approach for including existing and developing geometry tools into the Supersonic processes and a proposed timeline for development and implementation. Due Date: Dec 31, 2008

e) The Contractor shall deliver approved updated sets of geometry tools and implementations on a quarterly basis. The Contractor shall demonstrate any new capabilities and collect feedback from users for future inclusions or for corrective action. Due Date: Quarterly through Dec 31, 2009

*****End [R3] block addition*****

2.2.3 Performance Metrics/Standard (Required - Meets, Exceeds):
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).

End [R1] block addition

Begin [R2] block addition

2.3 Subtask 3:
These tasks are in support of the Supersonics (SUP) Program in the Fundamental Aeronautics Program.

NASA will provide detailed input for design parameters, but it is anticipated that implementation of these tasks will be an iterative procedure requiring considerable coordination between the Contractor and NASA POC during the drawing development in a), c), and e) below.

a) The Contractor shall develop engineering drawings in ProE for a new angle of attack mechanism concept being developed by NASA.

b) The Contractor shall deliver the resulting Angle of Attack Design from task 2.2a to the Fabrication single point of entry at LaRC and interface with fabrication personnel during the fabrication of the new equipment.

c) The Contractor shall develop engineering drawings in ProE for a new multi-port pressure probe mechanism concept being developed by NASA.

d) The contractor will deliver the resulting multiport pressure probe drawings from task 2.2c to the Fabrication single point of entry at LaRC and interface with fabrication personnel during the fabrication of the new equipment.

e) The Contractor shall develop engineering Drawings in ProE of a new Supersonics project icon concept for a display model under development at NASA. The contractor shall aid in developing a scheme for model fabrication, assembly and transport of this model.

f) The Contractor shall deliver the resulting supersonic concept icon drawings from task 2.2e to the Fabrication single point of entry at LaRC and interface with fabrication personnel during the fabrication of the new new display model.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (correspond to above tasks):

a) Completed Engineering drawings of new angle of attack mechanism completed and delivered to Fab SPE Due by: January 31, 2008

b) Completed Angle of attack mechanism delivered to NASA POC. Due by: March 31, 2008

c) Completed Engineering drawings of new multiport pressure probe completed and delivered to Fab SPE Due by: January 31, 2008

d) Completed Angle of attack mechanism delivered to NASA POC. Due by: March 31, 2008

e) Completed Engineering drawings of new concept icon display model completed and delivered to

Fab SPE Due by: December 31, 2007

f) Completed Supersonic concept icon display model delivered to NASA POC. Due by: December 31, 2007

2.3.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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).

End [R2] block addition

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R2]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

A. Existing specialized analysis, processing, and/or design tools
B. Existing models, databases, geometry, data descriptions, and/or test data
C. Computer workstations and CPU time

4. Other Essential Information:

Begin [R1] block addition

It is anticipated that the Contractor will be required to travel to and attend approximately two technical interchange meetings and technical conferences to present work; as coordinated by the Technical Monitor.

End [R1] block addition

5. Security Clearance:

6. Period of Performance:

Planned start date: [R2]April 24, 2007

Completion date: [R1]~~December 31, 2007~~
[R2]~~March 31, 2008~~
[R3]~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Jeffrey K. Viken
M/S: 442 Phone: 757-864-2875
Other POC (Optional): [R3]***Karl Geiselhart***
M/S: 442 Phone: 757-864-***6501***

TASK ORDER NUMBER: 056D3-NNL07AM89T Revision: 1 Change: 0 Date: September 13 2007

Title: User Interface Requirements for Spacecraft Autonomy for Vehicles and Habitats (SAVH)

1. Purpose, Objective, or Background (Optional)

The purpose of the Spacecraft Autonomy for Vehicles and Habitats (SAVH) project is to increase onboard autonomous system capabilities and to develop automation that is flexible so that capabilities can be distributed more evenly between the Flight Controllers and Flight Crew at different times of need. For the early stages of the project the focus is to demonstrate candidate software solutions that can assist both Mission Control Center (MCC) flight controllers on the ground and crew members in a vehicle or habitat with the myriad tasks required for scheduling, monitoring, and controlling to make vehicle or habitat operations successful. In addition, increased autonomy may change the locus of control from ground control to a more distributed system. A key requirement of a successful system is User Interface (UI) design to facilitate the use of automated tools from wherever control is needed. Crew Systems and Aviation Operations Branch (CSAOB) personnel have been in cooperation with a subgroup, the "Operations Processes and Evaluation Capabilities (OPEC)" multi-center team, to develop a deeper understanding of current International Space Station (ISS) and Shuttle Flight Controller roles, responsibilities and perspectives.

Revision 1 (9/13/07): Extends the period of performance three months to January 31, 2008 in continuation of NASA's support, updates the deliverables schedule and subtask 2.1.2 requirements, adds travel requirements, clarifies safety and organization Subtask 2.n, and updates the initial task order start date to May 16, 2007 (see [R1] below).

Technical Direction 1 (02/01/08): Documents the extension of the period of performance 1 month to February 29, 2008 as authorized by the Contracting Officer in Mod 2, dated January 17, 2008 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Technical Subtasks The Contractor shall perform the following technical subtasks:

2.1.1 Develop SAVH User Interface Design Guidelines document. (With Crew Systems and Aviation Operations Branch (CSAOB) personnel).

- Establish baseline for non-automated system (how it is done today). Understanding here may help establish requirements for the system.
- Document user interface guidelines applicable to the SAVH project.
- Document appropriate guidelines applicable to current year focus on electrical power system.
- Document methods that may be applied to evaluate interface and system performance.

Begin [R1] block update*

2.1.2 Identification of requirements to support the researchers examining the Flight Production Process. The Contractor shall assist in:

- Identifying the preliminary strengths and weaknesses of shuttle and ISS flight production processes

- Determine if processes are candidates for reuse and rationale.

- Document the rationale.

End [R1] block update*

2.2 Schedule of Technical Deliverables

DELIVERABLE	DATE
2.2.1 Design Guidelines document.	August 31, 2007

2.2.2 [R1] ***Identification of Requirements for Flight Production Process. January 31, 2008***

2.3 Technical 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 or MS Excel documents.

Meets: Performance criteria will be met by timely delivery of the required items with adequate and reasonable detail and clarity to accomplish specified objectives. Documentation of the supporting data and analyses will provide adequate detail to support formal NASA reporting. Exceeds: Performance criteria will be exceeded by early completion of specified deliverables, quality/quantity of deliverables in excess of requirements, or contributions that result in added value to experiment or demonstration results. Rapid response to changing requirements also exceeds performance criteria.

2.n Working Environment Safety and Organization Subtask (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1] ***support the requirements of this task order.***

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Contractor will have web access and printing capabilities for project on-line files and records on the NX system.

4. Other Essential Information:

[R1] ***Travel requirements: 2 trips to the Johnson Space Center, Houston, TX, associated with this work.***

5. Security Clearance: *None*

6. Period of Performance:

Planned start date: [R1] ***May 16, 2007*** Completion date: [R1] ~~October 31, 2007~~ [TD1] ~~January 31, 2008~~ ***February 29, 2008***

7. NASA Task Management:

Technical Monitor (Required): Cathy Adams

M/S: 152 Phone: 757-864-3040

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 005E5-NNL07AM90T Revision: 3 Change: 0 Date: September 26, 2008

Title: R2>Exploration and Space Operations Directorate and Flight Projects Directorate (ESOD and FPD)<R2 Configuration & Data Management (C&DM) Support

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to provide Configuration and Data Management (C&DM) Support to the Exploration and R2>Space Operations Directorate and the Flight Projects Directorate.<R2

Revision 1 (8/13/08): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support requirements (see R1 below, Section 6)
Revision 2 (5/21/08): Updates the organizational references (including the task order title), clarifies safety and organization Subtask 2.n, updates the initial task order start date to July 2, 2007, and adds new Primary Technical Monitor (see R2 above and below).
Revision 3 (9/26/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see R3 below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

The ***ESOD and FPD Core Offices*** and Projects are responsible for performing C&DM functions. Due to the nature of each Project, there may be varying C&DM responsibilities. Unless otherwise specified, the Contractor shall perform the activities noted on the C&DM Activities List (see Appendix 1).

Deliverables:

1. ***ESOD and FPD*** Progress Reports by Project shall include:
    a. Work performed during the month
    b. Upcoming project activities for the next 3 months
    c. Upcoming project travel (purpose of travel, destination, cost estimate) for the next 3 months
    d. Upcoming leave for the next 3 months
    e. Issues and Recommendations

Due Date: Monthly (Deliver to ***ESOD and FPD*** Business Managers)

2. Report on existing C&DM documents by Project shall include:
    a. Listing of controlled artifacts and status of each
    b. Per each activity (formal reviews, tiger teams, technical reviews, staff meetings, etc) , report on the # of action items and current status

Due Date: Monthly (more frequent if Project Manager requests) (Deliver to Project Manager (PM) and Program Analyst)

3. Formal Review activities (if requested by the Project Manager):
    a. Prepare C&DM slides and present C&DM slides (if approved by PM).
    b. Record action items and interface with panel members as appropriate.
    c. Once actions are finalized by the panel, distribute information to Project Points of Contact (POC) and PM.
    d. Track actions through the entire completion and approval process.
    e. Report status of actions per "Deliverable #2."

Due Date: Per Project Schedule (Deliver to Project Manager). Item "c" should be delivered to Project Manager and POC's within 5 business days after the end of the review.

4. Project closure reports shall include:
    a. Listing of controlled artifacts and status of each
    b. # of action items and current status
    c. Location of all Project items
    d. Adjust user access to library materials based on R2>applicable Business Managers' approvals<R2.

Due Date: 30 days prior to Project completion (Deliver to ESOD or FPD Business Managers and Project Manager)

Metrics:

a) The Contractor shall deliver all deliverables on time.
b) The Contractor shall follow the guidelines established in NASA-STD-0005 (draft) and NPR 8040.1 (draft).
c) For new C&DM requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline C&DM plan and schedule within one month of task initiation. This assessment and planning activity shall be documented in the C&DM Plan.

Standard 1: Develop and deliver Monthly ESOD and FPD Progress Reports by Project.

CUSTOMER SERVICE/RATING:

Excellent: The Progress Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ***ESOD and FPD*** Business Managers upon delivery to review the report.
Very Good: The Progress Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ***ESOD and FPD*** Business Managers in a timely manner.
Satisfactory: The Progress Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ***ESOD and FPD*** Business Managers.
Poor: The Progress Report does not meet requirements outlined in "Deliverables." The Progress Report is not delivered on the specified date and is not reviewed with the ***ESOD and FPD*** Business Managers.
Unsatisfactory: No Progress Report is delivered to the customer, and the ***ESOD and FPD*** Business Managers have given no waiver.

Standard 2: Develop, maintain and report on existing C&DM documents by Project

CUSTOMER SERVICE/RATING:

Excellent: Status reports are updated and delivered on or before the date established 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 with accuracy and are reviewed with the customer.
Satisfactory: Status reports are updated and delivered on or before the date established with accuracy.
Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established.

Standard 3: Develop, deliver and present (when directed by the Project Manager) on Formal Review C&DM activities.

CUSTOMER SERVICE/RATING:
Excellent: The Formal Review information is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with appropriate Project personnel upon delivery to review the report.
Very Good: The Formal Review information is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews information with appropriate Project personnel in a timely manner.
Satisfactory: The Formal Review information is delivered to the customer on the specified due date with minimum errors. Contractor reviews information with appropriate Project personnel.
Poor: The Formal Review information does not meet requirements outlined in "Deliverables." It is not delivered on the specified date and is not reviewed with the appropriate Project Personnel.
Unsatisfactory: No Formal Review information is delivered to the customer, and the Project Manager has given no waiver.

Standard 4: Develop and deliver a Project Closure Report.

CUSTOMER SERVICE/RATING:
Excellent: The Project Closure Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with R2applicable (ESOD or FPD) Business Manager and Project Manager upon delivery to review the report.
Very Good: The Progress Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with R2applicable (ESOD or FPD) Business Manager and Project Manager in a timely manner.
Satisfactory: The Progress Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with R2applicable (ESOD or FPD) Business Manager and Project Manager.
Poor: The Progress Report does not meet requirements outlined in "Deliverables." The Progress Report is not delivered on the specified date and is not reviewed with the R2applicable (ESOD or FPD) Business Manager and Project Manager.
Unsatisfactory: No Progress Report is delivered to the customer, and no waiver has been given by either of the Business Managers or the Project Manager.

2.1 Subtask 1 -- *ESOD and FPD* Core C&DM Support:

In support of the ESOD and FPD Core, the contractor shall perform the following requirements:

a. Review Draft R2>Flight Projects Directorate and Exploration and Space Operations Configuration Management Plans<R2 and make necessary changes to be compliant with NASA-STD-0005 (draft) and NPR 8040.1 (draft).
b. Evaluate recommended items to be configuration controlled and report findings to the FPD Business Management for approval to be included in the configuration management program.
c. Establish and maintain the ESOD and FPD Core directory system (currently NX).
d. Populate directory system with ESOD and FPD Core artifacts (i.e., ESOD and FPD org charts,

plans, presentations, etc).

e. Coordinate the Network user accounts and control of user access to the directory system.
f. Notice of Clarification (NOC item) Proposal Teams, New Programs, and Projects. The Contractor shall provide Configuration and Data Management 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.
g. Attend ESOD and FPD Business Managers R2biweekly staff meeting and coordinates Agency C&DM updates and changes.
h. All project travel requests need to be approved by the R2applicable ESOD or FPD Business Manager prior to traveling.
i. All overtime requests need to be approved by the R2applicable ESOD or FPD Business Manager prior to working the overtime.
j. Implement approved recommendations from Safety and Mission Assurance audits.
k. Develop, maintain and present C&DM training materials as required.

2.2 Subtask 2 -- ESOD and FPD Project C&DM Support:

C&DM of the ESOD and FPD Projects requires the collection of tremendous amounts of information from team members and stakeholders outside the ESOD and FPD Projects.

2.2.1 Configuration and Data Management:

For items created by the ESOD and FPD Projects (i.e., documentation, hardware, software, changes, waiver requests, and deviations, etc.) C&DM support shall be performed as follows:

a. Attend Project team meetings.
b. Create and implement a Project C&DM Plan.
c. Identify the configuration items to be controlled for each project.
d. Establish and maintain the ESOD and FPD Project directory system (currently NX). Control electronic and hardcopy access to directory system with emphasis on proprietary restrictions.
e. Coordinate project and WBS level Configuration Control Board (CCB) activities.
f. Serve as secretary of the project and WBS level CCBs.
g. Perform Configuration & Data Management audits.
h. Review contractor C&DM Plans to ensure compliance with above referenced Project C&DM Plan and perform audits periodically based on project schedule and complexity to verify effective C&DM implementation.
i. Coordinate all Project document releases.
j. Ensure Project material is placed on the directory system in a timely manner. This includes, but should not be limited to: baselined documents; draft documents and analyses; technical papers; meeting minutes/actions; review presentations; Center Management Council presentations; etc.

2.2.2 Action Item/Receivable Deliverable Management:

Action Item (AI) documentation shall be tracked and available to the ESOD and FPD team through the

following:

a. Continued implementation of AI tracking for reviews and technical interface meetings.
b. Maintain AI system processes; database; and metrics.

2.n Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R2>support the requirements of this task order.<R2

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Computer equipment and associated software needed to perform the duties of this task.

4. Other Essential Information:

(1) Travel will be required for each of the subtasks listed above. Each organization, program or project will provide funds to cover travel costs.

(2) 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 this contract.

(3) Special training may be required from time to time. The Technical Monitor will review the training requirements and coordinate the requirements with the Contractor with the appropriate rationale.

(4) Attendance at conferences may be required from time to time. The Technical Monitor will review the conference agenda and coordinate the requirements with the Contractor with the appropriate rationale.

(5) Due to the critical nature of project work, the Contractor may need to work beyond the normal work schedule with reasonable compensatory allowances to maintain personal safety and health.

(6) All deliverables will be prepared in Microsoft Office.

(7) Participation will be required in meetings, teleconferences, and VITS as necessary.

(8) The contractor is required to sign a Non-Disclosure Agreement.

5. Security Clearance: The contractor is not required to have a security clearance.

6. Period of Performance:

Planned start date: R2July 2, 2007 Completion date: R1~~December 31, 2007~~
R3~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Primary Technical Monitor (Required): **Yvonne Dellapenta**
M/S: 494 Phone: 864-2760

Alternate Technical Monitor: **Kathryn Ferrare**
M/S: 494 Phone: 864-3776

Appendix 1:

Project:	
C&DM Analyst	

	C&DM Tasks
General Activities	
	Attend weekly staff/tag-up meetings
	Attend major meetings (SRR, CDR, TIM etc.)
	Scan documentation when electronic version is not available, for signature pages, etc.
	Help enter data onto TTA's, verify correct format and email to the correct POC
	Move legacy data to NX
	Prepare CDs and notebooks to support reviews/meetings
	Provide templates for documents, presentations, etc.
	Review C&DM specific type documents for content and consistence
	Notify the Team as to any changes/updates to Agency/Project C&DM documents
	Submit and track documents for signature
	Prepare and update on a regular basis a listing of where the Project's C&DM configuration items are controlled (i.e., Systems Engineering Directorate, Research & Technology Directorate, etc)
	Ensure other Directorates involved in the Project are adequately controlling Configuration Items.
	Work closely with Project/Program Office to ensure compliance with higher level C&DM activities
	Prepare and conduct ESOD and FPD C&DM training
NX	
	Establish and maintain the ESOD and FPD Project directory system (currently NX).
	Control electronic and hardcopy access to directory system with emphasis on proprietary restrictions.
	Collect data and add to NX
Control Change Board	
	Assign numbers and maintain CR Database
	Set-Up (date, time, agenda, meeting room)

	Prepare Change Control Board (CCB) packages
	Serve as Secretary for CCB
	Record minutes and actions
	Ensure action/change request and associated documentation on NX
	Submit and track documents for signature
C&DM Plan	
	Create and baseline C&DM Plan
	Maintain the C&DM Plan
	Place C&DM document under configuration control
	Ensure periodic audits are against the C&DM plan
Audits	
	Conduct Audits internal and external
ESOD and FPD Monthly Status Report	
	ESOD and FPD Progress Report by Project:
	-- Work performed during the month
	-- Upcoming project activities for the next 3 months
	-- Upcoming travel (purpose of travel, destination, cost estimate) for the next 3 months
	-- Upcoming leave for the next 3 months
	-- Issues and recommendations
Project Controlled Item List	
	Gather status and report on controlled items (such as Action Items, documentation status, parts status, hardware/software, etc.)
	Provide metrics (i.e., number closed; estimated time of closure; etc.)
Actions	
	Maintain database and track process to closure (major meetings, working groups, etc.)
	Submit and track documents for signature

TASK ORDER NUMBER: 011D2-NNL07AM91T Revision: 0 Change: 0 Date: 4/19/2007

Title: SEDBOT Project

1. Objective

SEDBot project is to design and build an autonomous, outdoor capable, wheeled rover platform for mounting and demonstrating a variety of atmospheric and geologic instruments. The SEDBot is to provide NASA LaRC a mobile, robotic platform for the development and demonstration of rover based science instruments at LaRC.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

The Contractor shall provide mechanical engineering design services to detail the part designs and assemblies to fabricate a SEDBot using the NASA LaRC supplied configuration and component sizes. NASA LaRC will provide the overall system engineering and integration of the rover mechanical design and electrical system integration. The SEDBot mechanical design Contractor shall ensure that the part designs are technically correct, mechanically feasible, and cost effective to meet the SEDBot requirements. The Contractor shall coordinate and maintain contact with the various disciplines involved with the SEDBot project.

2.1 The Contractor shall deliver detailed mechanical part designs for the SEDBot based on the NASA LaRC supplied ProE mechanical assembly skeleton layout using ProE, Wildfire version 2 software and the NASA LaRC Interlink commonspace file storage.

2.1.1 Deliverables and Schedule

The Contractor shall complete and store in the commonspace folder a complete mechanical configuration model that contains the detail mechanical parts models to be fabricated for the SEDBot by 6/18/2007.

2.1.2 Performance Metrics

The SEDBot piece ProE part models can be electronically downloaded to be manufactured using the fabrication facilities at NASA LaRC.

2.2 The Contractor shall deliver detail parts and assembly drawings for the mechanical elements to be fabricated to build the SEDBot Rover and the drawing format shall conform to the NASA LaRC drawing standards.

2.2.1 Deliverables and Schedule

The detail parts drawings complete for review by the technical monitor by 8/31/2007. The assembly drawings complete for review by the technical monitor by 10/26/2007.

2.2.2 Performance Metrics

The drawings delivered for review are technically correct and all relevant dimensions are documented.

2.3 The Contractor shall participate in a regular, scheduled project status meeting to advise the project

manager of issues that need to be elevated to a higher level for resolution.

2.3.1 Deliverables and Schedule

Part models and drawings delivered on schedule. Project schedule for deliverables is maintained and issues related to the mechanical design are resolved by the Contractor without the technical monitors direct input before it impacts the projects schedule.

2.3.2 Performance Metrics

Schedule due dates met.

2.4 The Contractor shall implement any agreed to problem resolution during the engineering development process up to and including the fabrication and assembly of the piece parts that is within the scope of this task for the Contractor.

2.4.1 Deliverables and Schedule

This is an on going requirement. The Contractor shall implement changes as deemed necessary by the technical monitor in order for the SEDBot design to function as required.

2.4.2 Performance Metrics

Requested changes to the design during the development are incorporated it to the finished design.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to the extent the support required in this task order will allow.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Government will provide the following base support: Government-controlled working space, material, equipment, services (including automated data processing), or other support, which the Government determines can be made available at, or through any NASA installation where this task will be performed. The Government will furnish or make available to the contractor any documentation deemed necessary by the Government to accomplish this task. Government to furnish access to ProE and Interlink license at the start of the project.

4. Other Essential Information:

Deliverables Schedule Summary Table:

	Title	Freq/Due Date	Format:
1.	SEDBot ProE configuration model	06/18/2007	Interlink file folder

2.	Title SEDBot ProE detail parts models	Freq/Due Date 06/18/2007	Format: Interlink file folder
3.	Title SEDBot ProE detail parts drawings	Freq/Due Date 08/31/2007	Format: Interlink file folder
4.	Title SEDBot ProE assembly drawings	Freq/Due Date 10/26/2007	Format: Interlink file folder

5. Security Clearance:
A DD 254 is not required for this requirement.

6. Period of Performance:
Planned start date: 5/29/2007 Completion date: 10/26/2007

7. NASA Task Management:

Technical Monitor (Required):
Charles M. Boyer M/S: 432 Phone: 864-8374

Other POC (Optional):
Michael J. Fuchs M/S: 432 Phone: 864-4106

TASK ORDER NUMBER: 012D2-NNL07AM92T Revision: 2 Change: 0 Date: April 30, 2009

Title: Exploration and Science Mechanical Development Support

1. Purpose, Objective, or Background (Optional)

The Mechanical Systems Branch has the responsibility to assist NASA Projects with the Mechanical engineering design and development of systems to support a broad spectrum of activities that include feasibility studies, proposal development, laboratory systems, flight systems, and other in support of the NASA mission for exploration and ongoing atmospheric studies in conformance to responsibilities stated in the LaRC Organizational Unit Plan LMS-OUP-D2, responsibilities.

This task will provide engineering services to support ongoing engineering design and development activities under the functional responsibility of org the Mechanical Systems Branch.

Revision 1 (3/20/08): Extends the period of performance 12 months in continuation of NASA's support, updates/clarifies some details, and clarifies anticipated travel and small purchase requirements (see [R1] below).

Revision 2 (4/30/09): Extends the period of performance 4 1/2 months to September 30, 2009 in continuation of NASA's support (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract Paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATION (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

2.1 Engineering services for the design and development of test hardware for the Exploration initiative Flight Article program

The Contractor shall provide expert guidance to junior and mid level engineer on the engineering design, analysis, development, and delivery of test hardware to support project milestones. Expert advice shall be based on engineering experience in the design and development and production of mechanical systems. The Contractor shall also be responsible for the review of engineering drawings to ensure compliance to ASME Y14.5 drafting standards and to ensure engineering specifications are explicitly annotated in engineering documentation to support the production of end items without need to rework due to lack of sufficient specifications or for the use of specifications not currently available by available manufacturers. The Contractor shall also develop and produce technical specifications and procedures for assembly, integration and testing of project hardware to produce certification of compliance of delivered end item with established performance requirements.

2.1.1.1 The Contractor shall review and certify Engineering Drawings

2.1.1.1.1 The Contractor shall review and ensure engineering drawings conform to ASME Y14.5 Drafting standards. The Engineering drawings shall also be reviewed to ensure specifications can be met by readily available manufacturing methods. Drawing specifications shall be certified to ensure proper tolerances callouts are made to ensure next level assemblies to support production of upper level assemblies. Drawings shall also be reviewed to ensure all required processes, specifications and parts are explicitly called out to support successful production of intended hardware.

2.1.1.1.2.1 DELIVERABLES

2.1.1.1.2.1.1 Engineering drawings ready for signature by Branch level authority. Contractor signature of the review block will certify drawing correctness for drafting standards, completeness of technical information and specifications needed for the production of desired product, and compatibility of specifications to ensure proper compatibility to lower and upper level assembly or processes.

2.1.1.1.2.1.2 The Contractor shall provide monthly report of approved drawings. Report shall include number of drawings reviewed, list of engineering drawing titles/number reviewed, required actions to final approval, and final disposition of drawings.

DUE DATE: Ongoing deliverable. Deliverable due not longer than two days from submission of drawing for review. Deliverable for this item is defined as return of drawing with feedback for correction by author or delivery of drawings for signature by Branch Authority.

2.1.1.1.2.2 Monthly report of engineering documentation activity. Report shall contain number of drawing reviewed, number of drawings returned to author for correction, author of engineering drawings reviewed.

2.1.1.2 The Contractor shall provide technical consultation to the engineering design and development of hardware to meet project requirements.

2.1.1.2.1 The Contractor shall provide technical consultation in design-for-fabrication of hardware to meet project requirements.

2.1.1.2.2 The Contractor shall provide consultation in engineering and sizing of load-critical components to ensure parts meet structural, vibration, thermal and material compatibility requirements are met.

2.1.1.2.3 The Contractor shall provide consultation in the modeling of engineering design with the use of [R1>] ~~PTC Pro-Engineer~~ parameter [<R1] CAD software.

2.1.1.2.4 The Contractor shall provide consultation in the analysis required for the proper sizing of designed components to meet hardware performance requirements.

2.1.1.2.0.1 DELIVERABLES

2.1.1.2.0.1 Monthly report of consulting activity.

Report shall contain number of contacts, recommendations resulting in quality of product under production, savings to the government resulting from advice (cost and/or schedule), or benefit to the engineering process. The report shall also provide recommendations to improve engineering processes, including training, tools, tool configuration, and any other engineering design development process related to the delivery of engineering products.

2.1.1.3 The Contractor shall develop and produce approved procedures to support the successful accomplishment of project milestones. All Procedures shall be filed with the project

configuration manager. The Contractor shall ensure all needed signatures of approval are collected before the activity controlled by such procedures can take place.

2.1.1.3.1 The Contractor shall develop approved test procedures for the successful verification that tested hardware components, sub-systems or systems comply with all performance requirement. The Contractor shall also provided modifications as needed to accommodate and document alternate test conditions.

2.1.1.3.2 The Contractor shall develop assembly procedures for the production of assembly of components into sub-assemblies and up to the production of full assemblies. Operations and processing procedures are also within the scope of this sub-element.

2.1.1.3.0.1 Deliverables

2.1.1.1.2.1.1 Approved procedures completed and approved by project management in time to proceed with procedure controlled activity per project schedules.

2.1.1.1.2.2 Monthly report of engineering documentation activity. Report shall contain status of procedures under development and status of activities controlled by approved procedures authored by the Contractor.

DUE DATE: Ongoing deliverable.

2.1.3 Performance Metrics/Standards

MEETS (Performance Elements 2.1.1.1-3):

1. (PE 2.1.1.1) Engineering Drawing author receives feedback for corrective action within one day of submittal.
2. (PE 2.1.1.1) Final engineering drawing deemed free of engineering specification discrepancies when delivered to fabrication.
3. (PE 2.1.1.1) Items produced by Contractor-approved engineering drawings do not have to have rework done due to engineering drawing errors.
4. (PE 2.1.1.2) Engineering consultation enables engineers and designers meet delivery meet all performance requirements while delivering finished engineering designs on schedules as defied by the project.
5. (PE 2.1.1.3) 100% of procedures completed, approved, and distributed in time for implementation of the planned procedure-controlled activity per project schedules.

EXCEEDS:

1. (PE 2.1.1.1) Design author receives feedback that results in significant schedule or cost savings for production of final engineering products specified by engineering drawings. Estimates of cost/schedules benefits to the government shall be certified by the gaining organization/engineering product author.
2. (PE 2.1.1.1) 98% or above of engineering drawings received for branch approval are signed by the Branch authority without need to rework drawings.
3. (PE 2.1.1.2) Technical Consultations with Contractor results in significant in significant savings to the government. Savings can be quantified as project resources such as, cost, schedule, manufacturability,

and ease of operations among others. Benefits of Contractor contributions shall be quantified as part of the monthly reports.

4. (PE 2.1.1.3) Approved procedures authored by the Contractor result in significant benefit to the government over prior planned procedure-controlled activities. Quantification of the benefit include enhancement of safety to personnel and infrastructure, reduced cost and time for implementation, enhanced quality of engineering data collection for post test analyses.

2.2 (Requirement/subtask number two)

2.2. Exploration Support Equipment Development and Systems Engineering (Subtask 2):

2.2.1. The Contractor shall attend exploration activity project working group teleconferences in support of the equipment planning, development and design. Equipment GSE includes handling, shipping, lifting, test support hardware, prototype and proto-flight equipment, fabrication fixtures, instrumentation systems, and test systems.

2.2.2. The Contractor shall define, derive, track and support planning of verification for systems requirements needed for successful delivery of engineering products in support of the project development activity.

2.2.2.1. Developed and derived systems requirements shall be verifiable by identifiable test methods or by accepted analytical practices per established project standards.

2.2.2.2. All developed requirements shall have clearly identified Parent/Child relationship to sources of developed requirements.

2.2.2.3. Systems engineering support shall be provided for higher level systems and derived requirements derived for subcomponent level.

2.2.2.4. Systems engineering support shall be provided for flight, ground-test, prototype, and Ground support equipment.

2.2.2.5. The Contractor shall define interfaces and assure compatibility between major subsystems, including, mechanical structural/thermal, mechanisms, power, data, avionics, and data systems.

2.2.2.6. The Contractor shall develop all deliverables in accordance with negotiated project standards.

2.2.3. The Contractor shall design GSE, prototype, and flight equipment related to the exploration activity.

2.2.3.1. The Contractor shall provide concepts for GSE, and other equipment. Concepts may be sketched or produced in CAD. Sketches shall be created to support the working group activities and initiate designs.

2.2.3.2. The Contractor shall design GSE hardware. All designs shall be created in Pro/Engineer and Maintained in [R1>]~~Pro/Intralink~~ Pro-PDM[<R1] or current project defined configuration control archive on the CAEDM server.

2.2.3.3. The Contractor shall generate detail drawing for equipment designs.

2.2.4. Interfaces and Communication

2.2.4.1. The Contractor shall interface with the technical monitor and the exploration activity designers to define interfaces to the equipment to under development.

2.2.4.2. The Contractor shall interface with exploration activity operations personnel to define and capture functional requirements of equipment needed.

2.2.4.3. The Contractor shall provide analysts with design information required to structurally analyze the equipment hardware. The Contractor shall consult with ***analyst*** to optimize the structural design of equipment hardware.

2.2.4.4. The Contractor shall provide analysts with design information required to thermally analyze the equipment hardware. The Contractor shall consult with ***analyst*** to optimize the thermal design of equipment hardware.

2.2.5. The Contractor shall support exploration activity Reviews

2.2.5.1. The Contractor shall provide design and engineering data required to generate presentation slides for reviews.

2.2.6. The Contractor shall support fabrication efforts

2.2.6.1. When required, fabrication liaison shall be provided

2.2.7. Deliverables

2.2.7.1. Requirements for development of prototype, ground, test, flight, and ground support equipment.

2.2.7.1.1. Top level and derived requirements.

2.2.7.1.1.1. Due date: ongoing

2.2.7.1.2. Parent/child relationship between developed requirements.

2.2.7.1.2.1. Due date: ongoing

2.2.7.1.3. Traceability of engineering products to related requirements.

2.2.7.1.3.1. Due date: ongoing

2.2.7.1.4. Verification matrix for established requirements.

2.2.7.1.4.1. Due date: Ongoing

2.2.7.2. Design of required Equipment

2.2.7.2.1. Conceptual, ongoing as negotiated with the project office

2.2.7.2.2. Preliminary, ongoing as negotiated with the project office

2.2.7.2.3. Final, ongoing as negotiated with the project office

2.2.7.3. Drawings of required Equipment

2.2.7.3.1. Ongoing, as negotiated with the project office

2.2.7.4. Fabrication Liaison

2.2.7.4.1. Due date: ongoing

2.2.7.5. Update drawings to reflect as built condition

2.2.7.5.1. Due date: Ongoing, as negotiated with the project office.

2.2.8. Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date; Exceeds Requirements will be defined as delivery one week or more prior to due date

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R1>support the requirements of this task order<R1

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management

walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The government will provide access to source codes needed for the accomplishment of the assigned tasks. The Contractor shall be responsible to provide computer resources of enough capacity to accomplish the assigned tasks. Contractor computer resources shall be capable of running MSB standard source code clients that include PTC Pro-engineer, Pro-mechanica, and Pro-PDM; Collier Technology HypersizerPro; MSC NASTRAN, and PATRAN; MathLab; and Mathcad. Computer models Shall vary from very small to very large, including but not limited to computer models of full vehicle assemblies

4. Other Essential Information:

All engineering design tasks shall be performed with the use of standard CAD/CAE software tools as described in section 3 of this SOW. Engineering drawings shall conform to ASME Y14.5.

Begin [R1] block addition

A. The Contractor shall support project activities, including technical Interchange Meetings, Project Reviews, Field Operations and others that will require travel on behalf of the supported project. Although travel for the supported activities is highly variable and subject to change, it is estimated that the average collocated project activity will require support for two full days per meeting plus the necessary travel to and back from duty station on a frequency of one trip per month per contractor WYE supporting this task. The travel requirement shall be in place for the duration of this Task Order. For estimation purposes, the contractor shall use the average of three destinations, including Kenedy Space Flight Center, Johnson Space Flight Center, and Dryden Flight Research Center for proposed travel.

B. It is anticipated that small materials purchases will be necessary for the accomplishment of contracted tasks. Such material required for the accomplishment of requested tasks, shall be coordinated with the Technical Monitor.

End [R1] block addition

5. Security Clearance:

None Needed

6. Period of Performance:

Planned start date: 6/6/2007 Completion date: [R1>] ~~5/15/2008~~ [R2] ~~5/15/2009~~ ***9/30/2009***

7. NASA Task Management:

Technical Monitor (Required): William M. Berrios
M/S: 432 Phone: 864-7183
Other POC (Optional): Drew J. Hope
M/S: 432 Phone: 864-7278

TASK ORDER NUMBER: 002A4-NNL07AM93T Revision: 2 Change: 0 Date: November 5, 2008

Title: Configuration and [R2]***Data*** Management Support for ETDPO

1. Purpose, Objective, or Background (Optional)

New task supporting the Exploration Technology Development Program Office (ETDPO) for Configuration and [R2>]***Data Management (C&DM).***[<R2]

Revision 1 (10/23/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates and clarifies the deliverables schedule, and clarifies safety and organization subtask requirements (see [R1] below).
Technical Direction 1 (10/6/08): Adds an Alternate Technical Monitor (see [TD1] Section 7, below).
Revision 2 (11/5/2008): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with updated title, support requirements, terminology, deliverables and reporting schedule (see [R2] above and below)

2. Description of the Work to be Performed:

2.1 Development Tasks

The development task is associated with [R2>]***enhancing functions of***[<R2] the Exploration Technology Development Program (ETDP) [R2>]***C&DM processes.***[<R2] The Contractor shall coordinate all new C&DM developments with individuals identified by the ETDPO's [R2>]***Program Planning & Control Manager (PPCOM).***[<R2] The status of development task actions shall be delivered to ETDPO's [R2]***PPCOM*** and are noted below in 2.1.1.

The Contractor shall perform the following requirements:

1. *Review* existing C&DM policies, plans, standards and procedures at NASA HQ, NASA Centers, and industry and *recommend*, to ETDPO management, an approach to establishing sound, workable, cost effective C&DM processes for ETDP.
2. *Develop* and/or *adapt* policies/plans/procedures as required to implement that C&DM approach approved by ETDPO management.

*****Begin [R2] block update*****

3. Develop a plan for ETDP data archive.

2.1.1 Development Tasks Deliverables

Deliverable	Status Requirement
1. Recommendations	Ongoing
2. Developments • Processes and Procedures • Requirements	Ongoing
3. Special Reports C&DM policies, procedures and statuses	***Variable*** (typically quarterly)

*****End [R2] block update*****

2.2 Continuing Tasks

2.2.1 Configuration & R2*Data* Management

Products noted below shall be delivered to ETDPO's R2***PPCOM***. ETDP Configuration & R2***Data*** Management (C&DM) support shall be performed as follows:

1. *Evaluate* recommended items to be configuration controlled and *report* findings to the ETDPO for approval to be included in the configuration management program.
2. Facilitate the use and implementation of the ETDP configuration management processes and CM Plan.
3. R2>***Maintain the C&DM Plan for ETDP***.<R2
4. Coordinate network user accounts and user access control of the Configuration Management system.
5. *Develop* and *maintain* database entries for reporting configuration management activities to the ETDPO.
6. Serve as Secretary on the ETDP Control Board.
7. *Perform* Configuration Management audits and *assist* in quality assurance and physical audits.
8. Serve as the ETDPO Release Desk

2.2.2 Information Management

Configuration management for ETDP requires collecting and sharing of tremendous amounts of information from team members and stakeholders within the program and outside the program. Once this information is collected, data and knowledge shall be conveyed to ETPD team members to ensure proper review and configuration management through performance of the following requirements:

1. Coordination of implementation of the Exploration ESMD selected Information Management (IM) software (currently using Windchill).
2. Maintenance of ETDP archive.
3. Coordination of network user accounts and control of user access to the IM system.

2.2.3 Library Management

To ensure Configuration Management, an ETDP documentation library is required. The library will be the central location where documentation is stored. It includes deliverable documentation from ETDP Projects as well as correspondence and reports. Management of the ETDP library shall be performed as follows:

1. *Maintain* the master library for all baselined documents and *assist* in the classification and filing of documentation.
2. Review all documentation for compliance with ETDP processes.
3. Coordinate all ETDP document releases, changes, waiver requests, and deviations.
4. Control electronic and hardcopy access to library materials with emphasis on proprietary restrictions.
5. Maintain ETDP data archive.
6. R2>***Maintain the project electronic library.***<R2

2.2.4 Action Item/Receivable Deliverable Management

To ensure effective ETDP Configuration Management, Action Item (AI) documentation shall be tracked and available to the EFPD team through performance of the following requirements:

1. Continued implementation of AI tracking for reviews and technical interface meetings to include ESMD Quarterly Program Management Reviews (QPMR), Technical Integration Meeting (TIM), Business Integration Meeting (BIM), ETDP Project Baseline Reviews.
2. Maintenance of AI system processes and database.
3. Maintenance of receivable/deliverable system processes and database.

2.2.5 C&DM Agency Responsibilities

The continuing tasks provide maintenance of C&DM policies, process, and procedures developed as part of the development task. The Contractor shall perform continuing task actions as follows:

1. Coordinate ETDP electronic document activities/issues with contacts in the LaRC/agency IT community identified by the ETDPO's [R2]***PPCOM***.
2. Act as ETDPO POC for C&DM issues/activities.
3. Provide program management with *expert advice and recommendation* regarding agency and center C&DM policies and procedures.
4. Provide expert C&DM advice and guidance to ETDP projects personnel.
5. Keep program management and cognizant project personnel informed of pending changes in C&DM requirements at agency and center level.
6. Coordinate C&DM and document management related issues amongst ETDP projects personnel for policy/procedure issues and IT security and firewall issues.
7. Maintain the ETDP C&DM plan and library.
8. Archive and retain ETDP records.
9. Develop and maintain C&DM templates (documents, presentations, forms, etc.).

2.2.6 Continuing Tasks Deliverables

Deliverables	Due Date
1. [R2]***Document*** Control List Report with status	[R2]***Variable (typically quarterly)***
2. [R2>]***Progress Reports***[<R2]	Monthly
3. Action Item and Receivable/Deliverable Status Report	Weekly
4. Special C&DM reports and presentations to communicate ETDP's C&DM policies, procedures and statuses	[R1]Variable (typically quarterly)

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

Standard 1: Develop and deliver C&DM Control List Report with updated status to ETDPO.

CUSTOMER SERVICE/RATING:

Excellent: The ETDP C&DM Control List Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ETDPO R2***PPCOM*** upon delivery to review the report.

Very Good: The C&DM Control List Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ETDPO R2***PPCOM*** in a timely manner.

Satisfactory: The C&DM Control List Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ETDPO R2***PPCOM***.

Poor: The C&DM Control List Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ETDPO R2***PPCOM***.

Unsatisfactory: No C&DM Control List Report is delivered to the customer, and the ETDPO R2***PPCOM*** has given no waiver.

Standard 2: Develop and deliver Library Control List Report with updated status to ETDPO.

CUSTOMER SERVICE/RATING:

Excellent: The ETDP Library Control List Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ETDPO R2***PPCOM*** upon delivery to review the report.

Very Good: The Library Control List Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ETDPO R2***PPCOM*** in a timely manner.

Satisfactory: The Library Control List Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ETDPO R2***PPCOM***.

Poor: The Library Control List Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ETDPO PPCOM.

Unsatisfactory: No Library Control List Report is delivered to the customer, and the ETDPO R2***PPCOM*** has given no waiver.

Standard 3: Develop and deliver Action Item and Receivable/Deliverable (AIRD) Status Report with updated status to ETDPO.

CUSTOMER SERVICE/RATING:

Excellent: The ETDP AIRD Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ETDPO R2***PPCOM*** upon delivery to review the report.

Very Good: The AIRD Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ETDPO R2***PPCOM*** in a timely manner.

Satisfactory: The AIRD Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ETDPO R2***PPCOM***.

Poor: The AIRD Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ETDPO R2***PPCOM***.

Unsatisfactory: No AIRD Report is delivered to the customer, and the ETDPO R2***PPCOM*** has given no waiver.

Standard 4: Develop and deliver Special Reports and Presentations to ETDPO.

CUSTOMER SERVICE/RATING:

Excellent: The ETDP AIRD Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ETDPO R2***PPCOM*** upon delivery to review the report.

Very Good: The AIRD Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ETDPO R2***PPCOM*** in a timely manner.

Satisfactory: The AIRD Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ETDPO R2***PPCOM***.

Poor: The AIRD Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ETDPO R2***PPCOM***.

Unsatisfactory: No AIRD Report is delivered to the customer, and the ETDPO R2***PPCOM*** has given no waiver.

3. Government Furnished Items:

4. Other Essential Information:

(1) Travel will be required for each of the subtasks listed above. Each organization, program or project will provide funds to cover travel costs.

(2) 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 this contract.

(3) Special training may be required from time to time. The Technical Monitor will review the training requirements and coordinate the requirements with the Contractor with the appropriate rationale.

(4) Attendance at conferences may be required from time to time. The Technical Monitor will review the conference agenda and coordinate the requirements with the Contractor with the appropriate rationale.

(5) Due to the schedule critical nature of project work, the Contractor may need to work beyond the normal work schedule with reasonable compensatory allowances to maintain personal safety and health.

5. Security Clearance: N/A

6. Period of Performance:

Planned start date: July 2, 2007 Completion date: R1 ~~December 31, 2007~~ ***December 31, 2008***

7. NASA Task Management:

Technical Monitor: **Richard Law** R2> ***(Project Planning & Control Office Manager (PPCOM))*** <R2
M/S: 109 Phone: (757) 864-2184

Alternate Technical Monitor: TD1 **Pamela J. Stacy**
M/S: 109 Phone: (757) 864-4918

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 057D3-NNL07AM94T Revision: 2 Change: 0 Date: March 9, 2009

Title: Vibro-acoustic Analysis Support for CEV Heat Shield Design and Testing

1. Purpose, Objective, or Background (Optional)

In support of the Orion Crew Exploration Vehicle (CEV) Thermal Protection System (TPS) Advanced Development Project (ADP), LaRC is responsible for leading the design and analysis task for the flight aft heat shield up to the CEV Preliminary Design Review (PDR). The heat shield design and analysis task includes: developing a preliminary design for the heat shield carrier structure, determining the analysis strategy for the integrated heat shield thermal mechanical structural stress analysis, and performing the preliminary integrated heat shield thermal mechanical structural stress analysis. LaRC is also responsible for leading the structural testing and fabrication task. This task includes performing two phases of testing to identify material properties, failure modes and analysis correlation between the test specimens and the analysis models. This SOW is to provide contractor structural dynamics analysis support to supplement the LaRC CEV TPS ADP heat shield design and testing teams. LaRC civil servants and contractors will work as an integrated team for this design effort.

It is estimated that 1 WYE dynamic response analyst to support pre- and post-test vibration and acoustic testing would require the following skills:

1) Experience in the development of dynamic finite element models in MSC.PATRAN, including but not limited to use of two-dimensional shell elements and three-dimensional solid elements, specification of isotropic and orthotropic materials properties, specification of material damping, and specification of base, force and acoustic loadings..
2) Experience in the use of MSC.NASTRAN, including but not limited to dynamic analysis solutions 103 (normal modes) and 111 (frequency response), and random analysis via solution 111. Familiarity with stress and strain recovery is also required.

The following additional skills are desired:

1) Experience using the MSC.NASTRAN Random Analysis tool to perform random analysis.
2) Experience in updating finite element models using experimental data.
3) Development of finite element models from CAD drawings.

Technical Direction 1 (9/25/07): clarifies safety and organization Subtask 2.n and updates the initial task order start date to September 21, 2007 (see [TD1] below).
Revision 1 (8/06/08): Extends the period of performance 7 months to March 31, 2009 in continuation of NASA's support with some updated and clarified requirements, schedule, and GFI (see [R1] below).
Revision 2 (3/9/09): Extends the period of performance 6 months to September 30, 2009 in continuation of NASA's support with updated Subtask 1 Milestones, Deliverables, and Schedule, and GFI schedule (see [R2] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

The Contractor shall provide vibro-acoustic analysis support of the testing which will assist in the development of the CEV Heatshield designs. This support will entail vibro-acoustic modeling and analysis tasks including but not limited to the following:

2.1 (Requirement/subtask number one):

1. The Contractor shall Develop finite element dynamics models of vibration and acoustic panels, panel fixtures and Block II [R1](PICA) specimens, both with and without ablative TPS attached.

2. The Contractor shall perform post-test vibration and acoustic response (acceleration and strain) predictions and updates required for model validation of the Block II specimens.

3. The Contractor shall Develop finite element dynamics models of vibration and acoustic response, panel fixtures and alternate Block II [R1>](AVCOAT) specimen.[<R1]

4. The Contractor shall perform [R1>]post-test acoustic response (acceleration and strain) predictions and updates[<R1] required for model validation of the [R1>]alternate Block II specimen.[<R1]

5. [R1](DELETED) The Contractor shall develop dynamic models of the full-scale heat shield (including the structure and TPS) using validated panel models and perform vibration and acoustic response (acceleration and strain) predictions in support of the Preliminary Design Review (PDR)

6. The Contractor shall prepare documentation and reports associated with analysis efforts contained in [R1]1-4.

7. The Contractor shall attend structural testing and fabrication as well as heat shield design and analysis meetings/teleconferences in support of the development of the deliverables notes below.

2.1.1 Milestones (Optional):

Perform panel Block II vibration tests – Estimated Completion ~7/07
Perform panel Block II Acoustic tests – Estimated Completion ~7/07
Panel Vibration Block II Test Reports Delivered – Estimated Completion ~11/07
Panel Acoustic Block II Test Reports Delivered – Estimated Completion ~11/07
[R1>]Perform panel alternate Block II vibration tests – Estimated Completion ~10/08
Perform panel alternate Block II Acoustic tests – Estimated Completion ~9/08
Panel Vibration alternate Block II Test Reports Delivered – Estimated Completion ~[R2]***4/09***
Panel Acoustic alternate Block II Test Reports Delivered – Estimated Completion ~[R2]***4/09***[<R1]

2.1.2 Deliverables and Schedule (Required):

	Title	Freq/Due Date	Format
1.	Validated MSC NASTRAN dynamics models for Block II vibration and acoustic panel specimens.	30 days following completion of draft test report. – Estimated ~8/07	MSC NASTRAN output - electronic files to specified data server, and

			hardcopy.
2.	R1(DELETED*)* Pre-test predictions of vibration and acoustic response for Block I and alternate Block II panel specimens.	30 days prior to start of test. – Estimated ~1/08	MSC NASTRAN output - electronic files to specified data server, and hardcopy.
3.	Validated MSC NASTRAN dynamics models for R1>alternate Block II acoustic panel specimen.<R1	30 days following completion of draft test report. – Estimated ~R2***6/09***	MSC NASTRAN output - electronic files to specified data server, and hardcopy.
4.	R1***(DELETED)*** Predictions of vibration and acoustic response for full-scale heat shield	Estimated ~ 9/07	MSC NASTRAN output - electronic files to specified data server, and hardcopy.
5.	Project documents to support design reviews, analysis reports, etc.	Duration of Task Order	Electronic files (Word, PDF, etc)
R1> **6.**	R2***Initial*** report documenting validation efforts in support of deliverables 1 and 3.	R2>***Estimated 6/30/09***<R2	Electronic file in Word format.<R1
R2> ***7.***	***Revised report documenting validation efforts in support of deliverables 1 and 3.***	***At completion of task – Estimated ~9/09***	***Electronic file in Word format.***<R2

The Contractor shall keep the Technical Monitor, informed of task status and progress through regular correspondence and meetings. The Government has unlimited rights to all deliverables of this Order.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets Requirements will be defined as delivery by due date; Exceeds Requirements will be defined as delivery one week or more prior to due date

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [TD1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Government will provide the following base support: Government-controlled working space, material, equipment, services (including automated data processing), or other support, which the Government determines can be made available at, or through any NASA installation where this contract will be performed. The Government will furnish or make available to the contractor any documentation deemed necessary by the Government to accomplish this task. The Government is prepared to provide the documentation and/or equipment/office space listed below:

GOVERNMENT FURNISHED ITEM	WHEN TO BE FURNISHED
Office Space (including phone and Internet access)	TBD
Block II Vibration and Acoustic Draft Test Report	[R1>]11/08
[R1>]Alternate Block II Vibration[<R1] and Acoustic Draft Test Report	Estimated [R2]***4/09***
Phase II Panel Acoustic Test Plan	5/30/07
Phase II Panel Vibration Test Plan	5/30/07
CEV TPS ADP Documents	5/30/07
MSC/NASTRAN License	Duration of Task Order

Note: The government will not supply computers to support this effort. Information on minimum computer capabilities to run MSC/NASTRAN Software can be found at www.mscsoftware.com

4. Other Essential Information:

On site-contractors shall work during the normal duty hours for Langley Research Center (Monday through Friday from 6:00 am to 6:00 pm).

Place of Performance: NASA Langley Research Center.

5. Security Clearance: A security clearance is not required for this task.
Note: This activity requires the use of sensitive and ITAR controlled information. A Non- disclosure Agreement (NDA) shall be executed and kept on file. The personnel supporting this SOW shall be qualified to handle ITAR controlled information. All sensitive and ITAR controlled information shall be managed in accordance with NASA policy.

6. Period of Performance:

Planned start date: TD1 9/21/07

Completion date: R1> ~~8/30/08~~
R2> ~~3/31/09~~
9/30/09

7. NASA Task Management:

Technical Monitor (Required): Max Blosser
M/S: 190 Phone: 757-864-5192
Other POC (Optional): Steve Rizzi
M/S: 463 Phone:757-864-3599

TASK ORDER NUMBER: 058D3-NNL07AM95T Revision: 5 Change: 0 Date: March 26, 2009

Title: Impact Dynamics Analysis & Testing

1. Purpose, Objective, or Background (Optional)

NASA Langley Research Center's (LaRC) Structural Dynamics Branch (SDB) is currently working on several programs of national importance including the President's program to send astronauts back to the moon and onward to Mars. In particular, an advanced development program to investigate the best approach to safely land a scaled up and modernized Apollo-like capsule called Orion is now underway using Langley's Landing and Impact Research (LandIR) Facility, a 240-ft high gantry structure. Currently, controlled airbag landing concepts to reduce the Orion's parachute terminal velocity are being tested using highly instrumented boiler-plate capsules. In addition to space, there is a continuation of aeronautics research, which has been ongoing at the LandIR for over 30 years, in aviation safety concepts for crashworthiness.

Computer technology has advanced whereby landing concepts, energy absorbing devices, and aircraft crash scenarios can now be simulated to minimize expensive full-scale testing. Computer codes such as LS-DYNA, developed for modeling car crashes and for containment of nuclear material, are now available for modeling a large variety of impact problems including airbags, anthropomorphic dummies, landings, aircraft crashes, and ballistic impacts such as that of the debris that brought down the space shuttle Columbia. Test data can be used to validate computer models over a given domain of initial velocities and impact conditions. Once validated, these computer models can be used to quickly expand the test envelope and to perform "what if" parameter studies.

Revision History:

- **Revision 1 (8/9/07):** Adds anticipated training/travel requirement (see [R1] below, Section 4).
- **Technical Direction 1 (10/1/07):** clarifies safety and organization Subtask 2.1 (see [TD1] below).
- **Revision 2 (12/6/07):** Updates Sub-Task 2.3 to reflect increased anticipated effort and the knowledge of analysis codes required for the technical support (see [R2] below).
- **Technical Direction 2 (12/10/07):** Interchanges the Technical Monitor and Alternate POC (see [TD2] below).
- **Revision 3 (4/22/08):** Updates Sub-Task 2.2 to reflect increased anticipated effort, clarifies possibility of related testing work in deliverables for sub-tasks 2.2 and 2.3, adds financial reporting by sub-task to deliverables for all Sub-Tasks, associates Technical Point of Contact with each technical Sub-Task, extends Period of Performance, and changes Technical Monitor (see [R3] below).
- **Revision 4 (6/26/08):** Adds Sub-Task 2.4 and updates existing "Exceeds" performance metrics (see [R4] below).
- **Technical Direction 3 (10/23/08):** Adds new primary Technical Monitor (see [TD3] below, Section 7)
- **Technical Direction 4 (3/23/09):** Updates Technical Monitor status to include only one individual (see [TD4] below, Section 7)
- **Revision 5 (3/26/09):** Updates Sub-Tasks 2.2 and 2.3 to add new requirements and WYE support, discontinues Sub-Task 2.4, and extends the Period of Performance three months to 12/31/09 (see [R5] below).

2. Description of the Work to be Performed:

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

Specific projects and associated deliverables under this Task Order are described as sub-tasks below. For all of these sub-tasks, the primary deliverable shall be analytical impact and landing simulations of spacecraft and aircraft using the nonlinear dynamic finite element code LS-DYNA. Subcomponents to be modeled include hybrid impact dummies and energy absorbing features such as airbags or crushable structure. In addition, sub-tasks may also require [R3>]performing limited testing,[<R3] analyzing experimental dynamic data (typically using Matlab or LabView software) and performing test and analysis correlations for model validation. Knowledge of the underlying physics of impact will be required to be able to build and understand the model output. This knowledge must include an understanding of dynamic impact behavior and strength of materials including material behavior in the linear, plastic, and failure regimes, for both metals and advanced composites. Analysis of digital data acquisition and manipulation including filtering shall be performed as part of the validation of computer models. Modeling of multi-terrain impacts such as impacts of aircraft and spacecraft onto hard surfaces, soft-soil, and water shall also be performed for these programs. Thus, simulations may require the use of Lagrangian, Eulerian, or Smooth Particle Hydrodynamic (SPH) formulations within LS-DYNA. Simulations of ballistic impact such as turbine fan blade containment or impact of debris such as occurred during the Columbia accident may also be required.

2.1 Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [TD1]support the requirements of this task order.

2.1.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.1.2 Required date: Ongoing.

2.1.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

2.2 Crash Impact Analyses in Support of SRW Aeronautics Research: The Aeronautics research program within NASA was recently reshaped and reinvigorated to focus on foundational physics in a number of discipline areas across a wide range of flight regimes. One of these disciplines is Structures and Materials, which includes a sub-discipline topic of Rotorcraft Crashworthiness. This research program is funded under the Subsonic Rotary Wing (SRW) Aeronautics program. The crashworthiness research plan calls for work in multi-terrain impact simulations and development of a full-scale crash simulation of a composite prototype helicopter. Due to the highly integrated nature of this research with other program elements, it is difficult to specify discrete tasks with begin and end dates; however, for estimating purposes, the government anticipates that this sub-task can be accomplished by ~1 WYE of entry-level (<5 years experience) analyst support [R3>]and ~1 WYE of early-career (5-10 years experience) support with analysis/test expertise[<R3], [R5>]***~1/2 WYE senior technician -- full time beginning in summer.***[<R5]

A. The Contractor shall create, run, analyze, post-process, and validate multiple LS-DYNA dynamic finite element models to predict the multi-terrain impact response of a composite deployable energy absorbing concept, as well as a full-scale finite element model of a composite prototype helicopter. Models may require updating or refinement such as re-meshing using MSC-PATRAN with the LS-

DYNA preference [R2]or HyperWorks. Model files may also be required to be compatible with other codes (e. g., ABAQUS, NASTRAN). Most post-processing shall be done with LS-PREPOST [R2]or HyperWorks. Use of EnSight to make enhanced animations may be needed for some cases.

B. The Contractor shall validate the models through correlation with test data. Subsequent analyses may be required to determine the influence of modeling parameters on the level of test-analysis correlation. Model validation procedures shall conform to NASA Standard NASA-STD-7009, or other appropriate standards, as required.

C. The Contractor shall coordinate with test engineers and use test data from impacts onto multi-terrain to determine and/or modify the inputs for material models in LS-DYNA. Models include complex failure mechanisms and strain-rate effects. In addition, testing to fully characterize soft soil material properties for input into the LS-DYNA models will be required.

D. The Contractor shall create models using the MSC-PATRAN, [R2]HyperWorks and/or LSTC Pre-Post pre-processor using both explicit and implicit formulations of LS-DYNA. For example, the implicit version of LS-DYNA may be executed to correlate analytical predictions with quasi-static crush test data.

E. The Contractor shall support development of a full-scale finite element model of a composite prototype helicopter. The contractor will interface with test personnel to determine aircraft loading, CG position, and other inertial properties. Material characterization testing may be required to provide input for the FE model. This model will be fully integrated including accurate physical representations of the impact surface, landing or skid gear, airframe, subfloor, seats and attachment fittings, occupants, restraint systems, mass items such as rotor transmission and engines, other onboard devices such as cockpit airbags, cargo and restraint systems, and other external energy absorbing systems.

F. The Contractor shall support development of a shell-based finite element model of the composite-honeycomb, externally deployed energy absorber, including various cover options.

G. The Contractor shall become familiar with human occupant modeling approaches including ATB, GEBOD, MADYMO, and the occupant models embedded in LS-DYNA. In addition, the contractor shall become familiar with human injury criteria including Eiband whole body criteria, Head Injury Criteria (HIC), Dynamic Response Index (DRI), Brinkley Index, lumbar load criteria, etc. Finally, the contractor shall become familiar with relevant crash-related criteria including the Military Standard for Light Fixed and Rotary-Wing Aircraft (MIL-STD-1290); the DOD Joint Service Specification Guide for Crew Protection (JSSG-2010-7); requirements for emergency landing conditions as specified in the Federal Aviation Regulations (FAR) Parts 23, 27, and 29; and, aerospace performance standards for seat certification, as specified by the SAE.

H. (NOC) The Contractor may be requested to perform other analyses and associated design and testing activities to support this project.

Begin [R5] block addition*

I. The Contractor shall support experimental programs conducted at the Landing and Impact Research (LandIR) Facility sponsored by the Subsonic Rotary Wing (SRW) Aeronautics program and the Advanced Composite Technology (ACT) program. Duties shall include development and manufacturing of composite aerospace structures(test specimens); development and fabrication of test fixtures and other devices needed for material property, dynamic compression, and impact testing; test article preparation including installation of hard points, lifting brackets, and instrumentation; support for full-scale crash testing of aerospace vehicles including review of test procedures, required modifications to the LandIR facility, fabrication of cables and harnesses, and other incidental support. The Contractor shall conduct experiments both in the Subscale Impact Dynamics Laboratory (SIDL), and at the LandIR facility including the 70-ft. Vertical Drop Tower as well as the gantry facility. All test programs shall be performed according to established procedures and checklists. Safety procedures and guidelines shall be followed in performance of all duties.

End [R5] block addition*

2.2.1 (NOC) Deliverables and Schedule (Required):

[R3>]Sub-Task Period of Performance: July 12, 2007 – [R5]~~September 30, 2009~~ ***December 31, 2009***[<R3]

(1) Monthly progress reports

(2) Reports summarizing [R3>]technical approach, assumptions, loads, inputs and results for each test/analysis, including ~~each LS-Dyna analysis with~~[<R3] digital charts, graphs, animations, and jpeg pictures from LS-Post or other post-processing software such as Patran, [R2]HyperWorks, EnSight, Excel, MatLab, and Kaleidagraph.

(3) Test/Analysis correlation

(4) PATRAN [R2]and/or HyperWorks databases/session files, finite element models/input files of all models generated

(5) [R3]Analysis/test results files

(6) Powerpoint files summarizing [R3]test/analysis results in format determined by the customer

[R3>](7) Monthly planned vs. funded vs. actual financial report ($ and hours) for this sub-task.[<R3]

[R5>]***(8) Test specimens and hardware and laboratory support as noted above***[<R5.]

2.2.2 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Work completed accurately and on time as agreed upon for each NOC.

Exceeds:

(1) Work completed ahead of schedule, or suggestions by Contractor to make model development and/or analysis easier, more accurate, or more efficient.

(2) Superior documentation of work.

(3) [R4]Superior fidelity and accuracy of [R3]work.

[R3>]2.2.3 Technical Point-of-Contact for this Sub-Task: Karen Jackson, M/S: 495, Phone: 757-864-4147[<R3]

2.3 Support to Orion Landing System Advanced Development Project: This subtask supports the Orion Project Landing System – Advanced Development Project (ADP). The Landing System-ADP is responsible for directing the development of the landing attenuation system for the NASA Orion Crew Exploration Vehicle up through the Project's Preliminary Design Review. The analysis objective of the Landing System-ADP is to provide analysis support that enables the Agency to make an informed selection of the most advantageous landing attenuation system technology. This support includes: the generation of landing attenuation simulation results to provide feedback on requirements and assess the performance of various landing attenuation concepts; the identification of design or knowledge deficiencies; as well as recommendations for improvements. This work is sponsored by NASA-JSC and is highly schedule driven and variable, with project priorities shifting on an almost weekly basis. For these reasons, crisp tasks will be defined in real time; however, for estimating purposes the government estimates that this task can be accomplished by ~1 WYE of early-career (5-10 years experience) [R2] and ~1 WYE of senior ([R3]15+ years) analysis support, [R5>]***~1/4 WYE senior analyst -- half time starting immediately***[<R5]

A. The Contractor shall create, run, analyze, post-process, and validate multiple LS-Dyna dynamic finite element models to predict the capsule response to land and water impacts utilizing a variety of attenuation concepts. Models may require updating or refinement, such as re-meshing. Models/model files may also be required to be compatible with other codes (e. g., ABAQUS, NASTRAN). Most post-processing shall be done with the LS-Prepost software package provided by the LS-Dyna vendor, [R3>]PATRAN or HyperWorks[<R3].

B. The Contractor shall assess the accuracy of the models and simulations for various attenuation systems using existing or newly acquired experimental data.

C. The Contractor shall coordinate with test engineers and use test data from material characterization and attenuation concept component/subscale tests to modify the simulation models in LS-Dyna.

E. The Contractor shall investigate soil-modeling issues for land landings of the Orion capsule that incorporate various landing attenuation concepts. This will require the detailed understanding of soil behavior and creation of soil models for use in LS-Dyna simulations.

F. (NOC) The Contractor may be requested to perform other analyses and associated design and testing activities to support this project.

*****Begin [R5] block addition*****

G. The Contractor shall interface between test engineers and analysts modeling soil/sand impact tests for Orion. Selected half-scale boilerplate drop tests that were conducted started in July 2008 shall be analyzed and the data reduced, filtered, and plotted using dynamic data and Matlab data reduction software. The Contractor shall coordinate with the NASA test engineer for boilerplate tests impacting into sand which will commence this spring. The Contractor shall work with soil/sand impact models and soil/sand impact test procedures for characterization such as using an instrumented hemisphere to determine the variability of the sand.

*****End [R5] block addition*****

2.3.1 (NOC) Deliverables and Schedule (Required):

[R3>]Sub-Task Period of Performance: July 12, 2007 – September 30, 2009 [<R3]

(1) Weekly progress summaries and participation at weekly project meetings

(2) Reports summarizing [R3>]technical approach, assumptions, loads, inputs and results for each test/analysis, including ~~each LS-Dyna analysis~~ [R2]~~and/or test with~~[<R3] digital charts, graphs, animations, and jpeg pictures from LS-Post or other post-processing software such as Patran, [R2]HyperWorks, Excel, MatLab.

(3) Test and analysis correlations

(4) PATRAN, [R2]HyperWorks, or IDEAS databases files, finite element models/input files of all models generated

(5) [R3>]Analysis/test results files

(6) Powerpoint files summarizing [R3]test/analysis results in format determined by the customer

[R3>](7) Monthly planned vs. funded vs. actual financial report ($ and hours) for this sub-task.[<R3]

[R5>]***(8) Written Engineering report with description of tests, analysis of tests, and test data plots. September 30, 2009.***[<R5.]

2.3.2 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Work completed accurately and on time as agreed upon for each NOC.

Exceeds:

(1) Work completed ahead of schedule, or suggestions by Contractor to make model development, analysis and/or testing easier, more accurate, or more efficient.

(2) Superior documentation of work.

(3) [R4]Superior fidelity and accuracy of [R3]*work.*

[R3>]2.3.3 Technical Point-of-Contact for this Sub-Task: Karen Lyle, M/S: 495, Phone: 757-864-3588[<R3]

2.4 Crash Impact Analyses in Support of SFW Aeronautics Research: [R5]***(Discontinued)***

3. Government Furnished Items:

Test specimens

Test specimen instrumentation

Access to NASA specialized structural analysis software, including MSC/NASTRAN, MSC/PATRAN and MSC/DYTRAN, LS-DYNA, LS-Post, IDEAS, [R2]HyperWorks, etc.

Computer CPU time for structural modeling and analyses

Office space

[R1]It is anticipated that the Contractor will provide standard ODIN workstations.

[R4>]Additional background description for Subtask 2.4 is available upon request.[<R4]

4. Other Essential Information:

US Citizenship is required because contractor personnel will be exposed to ITAR information.

Dissemination of significant results through periodic technical interchange meetings at other NASA centers and/or international forums, along with associated travel, may be required as appropriate.

[R1]Training and related travel may be required to support this task, to be coordinated with government as needs arise.

5. Security Clearance: None

6. Period of Performance:

Planned start date: July 12, 2007 Completion date: [R3]~~December 31, 2008~~ [R5]~~September 30, 2009~~ ***December 31, 2009***

7. NASA Task Management:

[TD4,TD3]**Primary Technical Monitor:** Ed Fasanella
M/S: 495 Phone: 864-4345

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 013D2-NNL07AM96T Revision: 2 Change: 0 Date: November 13, 2008

Title: Exploration and Science Thermal Analysis and Test Support

1. Purpose, Objective, or Background (Optional)

The Structural and Thermal Systems Branch (STSB) of the Systems Engineering Directorate is responsible for the thermal analysis and test support of advanced aerospace flight vehicles and the test articles used to evaluate and qualify these vehicles. The analyses and tests range from manned and unmanned aircraft and space vehicles to individual system components, to test articles, facilities, and testing arrangements supporting these vehicles and their subsystems. The branch utilizes high-fidelity thermal analysis tools employing finite element modeling and analysis techniques, as well as simpler handbook computations to complete these tasks. A broad spectrum of activities that include feasibility studies; proposal development; and the development of laboratory systems, flight systems, and others in support of the NASA mission for exploration and ongoing atmospheric studies are conducted in conformance to responsibilities stated in the LaRC Organizational Unit Plan LMS-OUP-D2, responsibilities. A combination of skilled Civil Servant and contractor workforce is used to complete these analyses, and this task addresses the requirements for skilled contractor personnel to perform the analysis and test-support tasks under the functional responsibility of the Structural and Thermal Systems Branch.

All engineering design tasks require the use of standard engineering analysis software tools as described in section 3 of this SOW.

Revision 1 (5/22/08): Extends the period of performance 6.5 months to December 31, 2008 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R1] below).
Revision 2 (11/13/08): Extends the period of performance 9 months to September 30, 2009 in continuation of NASA's support (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract Paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATION (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

The scope of this SOW is to provide thermal analysis and test support for exploration, science, and aeronautics projects in the STSB. STSB has leadership and/or significant roles for the thermal area in several Exploration, Science, and Aeronautics Projects. These projects currently include Ares I-X, Pad Abort 1 (PA-1), Ares Upperstage Thermal, CEV TPS Advanced Development Project, Mars Science Laboratory (MSL) Entry Descent and Landing Instrumentation (MEDLI), Hypersonic Boundary Layer Transition (HyBoLT), Program to Advance Inflatable Decelerators for Atmospheric Entry (PAI-DAE), and Hypersonics (Falcon). In addition, STSB is frequently required to provide support to numerous projects in a "consultant" mode and is called on to provide support to the Integrated Design Center (IDC). The range of thermal analyses may include analysis of Environmental Control System (ECS) components, thermal response of structures to applied thermal loads, ablation analysis, and radiation analysis. During the period of performance, the Contractor shall support thermal analysis and/or testing tasks. The Government will clarify specific requirements for each activity through NOC's. These requirements will include the schedule and expected deliverables (including format).

2.1. Thermal Analysis And Test Support For Exploration, Science, And Aeronautics Projects (Subtask 1):

2.1.1 The Contractor shall provide thermal analysis and test support for Exploration, Science, and Aeronautics Projects in STSB. The range of thermal analyses may include analysis of Environmental Control System (ECS) components, thermal response of structures to applied thermal loads, ablation analysis, and radiation analysis. Thermal analysis may include conductive, convective and radiative aspects, and transient as well as steady-state solutions. Thermal tests supported may include arc jet tests, wind tunnel tests with aerothermal loading, thermal vacuum tests and thermal-structural tests. The generalized deliverables are described in Section 2.2.2 below.

2.2.2 Deliverables

2.2.2.1 Analysis models in electronic format, including model file, applicable results files, and any subsidiary files necessary to run the model.

2.2.2.2 Analysis reports documenting analysis work, model development, assumptions, requirements, cases run, results, issues and solutions.

2.2.2.3 Charts, tables, documents and electronic media documenting Contractor methods and results.

2.2.2.4 Source code (such as Fortran, C++ or Visual Basic) developed to automate running a model, analyzing results, or to support any STSB task.

2.2.2.5 Charts, tables, documents, photographs, and other data required for documentation of the results of all thermal tests supported.

2.2.3 Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date (NOC); Exceeds Requirements will be defined as delivery one week or more prior to due date (NOC).

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1] support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The government will provide access to source and executable codes needed for the accomplishment of the assigned tasks. The Contractor shall be responsible to provide computer resources of enough capacity to accomplish the assigned tasks. Contractor computer resources shall be capable of running STSB standard clients that include PTC Pro-engineer, Pro-mechanica, and Pro-PDM; Collier Technology HypersizerPro; MSC NASTRAN, PATRAN, and Patran Thermal; Intel C++ and Fortran compilers; AutoDesk Mechanical Desktop; C&R Thermal Desktop; MathLab; and Mathcad. Computer models shall vary from very small to

very large, including but not limited to computer models of full vehicle assemblies.

4. Other Essential Information:

5. Security Clearance:

None Needed

6. Period of Performance:

Planned start date: 7/12/2007 Completion date: R1 ~~6/15/2008~~
R2 ~~12/31/2008~~
9/30/09

7. NASA Task Management:

Technical Monitor (Required): **David M. McGowan**
M/S: 431 Phone: 4-4916
Other POC (Optional): **Scott A. Hill**
M/S: 431 Phone: 4-7029

1. Purpose, Objective, or Background (Optional):

Begin [R3] block update*
The purpose of this task is to develop soil constitutive properties for an LS-DYNA numerical simulation of the Orion Crew Exploration Vehicle (CEV) landing on soil. This work will include: evaluation of soil characteristics at a potential landing site for the CEV; and in-situ and laboratory soil testing to develop constitutive properties for an LS-DYNA soil numerical model that encompass the extremes of the soils observed at the candidate landing site. The proposed landing site is the pad areas around Launch Complex 39 at KSC.
End [R3] block update*

Revision 1 (11/13/07): Extends the period of performance 4.5 months to April 30, 2008 to accommodate later than anticipated start and site visit dates, updates the initial task order start date to August 28, 2007, clarifies safety and organization subtask requirements, adds a third candidate landing site, and gantry soil testing, and updates other requirements (see [R1] below).
Revision 2 (2/15/08): Adds two soil assessment requirements and (3/5/08) extends the completion date two weeks to May 16, 2008 (see [R2] below).
Revision 3 (3/3/09): Reactivates the task for NASA's convenience with a new period of performance ending May 29, 2009, added and/or updated requirements, and new Technical Monitor (see [R3] above and below).
Note: For historical details deleted for clarity and/or convenience see previous versions of this PWS located on the electronic task order system (ETOS).
Technical Direction 1 (05/18/09): Documents the extension of the period of performance 1 month to June 30, 2009 as authorized by the Contracting Officer in Mod 5, dated May 1, 2009 (see [TD1] below, Section 6).

2. Description of the Work to be Performed:Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Begin [R3] block update*
2.1 Subtask 1: Develop constitutive properties for an LS-DYNA soil numerical model:
In this subtask, the Contractor shall perform laboratory tests on the soil samples previously gathered at KSC to develop the required soil constitutive properties for the LS-DYNA soil and crushable foam model (Material Type 5). These properties include: elastic shear modulus; unloading bulk modulus; shear failure surface parameters; and mean stress intercept of shear failure surface (see LS-DYNA Theory Manual, www.lstc.com/pdf/ls-dyna_theory_manual_2006.pdf). As a minimum the following geotechnical laboratory tests shall be performed to characterize the soils: grain size distribution; moisture content; minimum and maximum bulk density; grain density; hydrostatic compression; uniaxial strain; and triaxial compression. In development of these tests, appropriate stresses shall be applied to represent the soils in the range anticipated for the proposed passive landing system. In recent tests of the proposed passive landing system, the pressures ranged from 50 psig to 70 psig. From the geotechnical laboratory tests and in-situ data, the input parameters for the LS-DYNA soil models shall be developed by the Contractor. Where applicable, geotechnical soil tests shall be performed according to referenced testing standards.

2.1.1 Milestones (Optional): TBD

2.1.2 Deliverables and Schedule (Required):
Informal report documenting the soil characterization, geotechnical soil tests, and development of the LS-DYNA constitutive properties for the soil models. The soil models shall be provided in a LS-

DYNA Material Type 5 format that allows for direct application to numerical model simulations. Required by: May 27, 2009.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

The minimum acceptable level will be an informal report delivery upon completion of the soil constitutive model development. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and range of concepts that have potential for improved dynamic simulation of the soil/CEV impact.

*****End R3 block update*****

*****Begin R3 block addition*****

2.2 Subtask 2: Determine grain size distribution for an LS-DYNA soil numerical model:

In this subtask, the Contractor shall perform laboratory tests on soil samples provided by LaRC. The following geotechnical laboratory tests shall be performed to characterize the soils: grain size distribution. In development of these tests, appropriate stresses shall be applied to represent the soils in the range anticipated for the proposed passive landing system. In recent tests of the proposed passive landing system, the pressures ranged from 50 psig to 70 psig.

2.2.1 Milestones (Optional): TBD

2.2.2 Deliverables and Schedule (Required):

Informal report documenting the grain size distribution of the soil samples provided by LaRC. Required by: April 6, 2009.

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

The minimum acceptable level will be an informal report delivery upon completion of the grain size distribution. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and range of concepts that have potential for improved dynamic simulation of the soil/CEV impact.

2.3 Subtask 3: Develop constitutive properties for an LS-DYNA soil numerical model:

In this subtask, the Contractor shall verify that the single soil sample gathered in the area of the KSC Launch Complex 39 pads is representative of the entire launch pad area in developing the required soil constitutive properties for the LS-DYNA soil and crushable foam model (Material Type 5). These properties include: elastic shear modulus; unloading bulk modulus; shear failure surface parameters; and mean stress intercept of shear failure surface (see LS-DYNA Theory Manual, www.lstc.com/pdf/ls-dyna_theory_manual_2006.pdf). As a minimum the following geotechnical laboratory tests shall be performed to characterize the soils: grain size distribution; moisture content; minimum and maximum bulk density; grain density; hydrostatic compression; uniaxial strain; and triaxial compression. In development of these tests, appropriate stresses shall be applied to represent the soils in the range anticipated for the proposed passive landing system. In recent tests of the proposed passive landing system, the pressures ranged from 50 psig to 70 psig. From the geotechnical laboratory tests and in-situ data, the input parameters

for the LS-DYNA soil models shall be developed by the Contractor. Where applicable, geotechnical soil tests shall be performed according to referenced testing standards.

2.3.1 Milestones (Optional): TBD

2.3.2 Deliverables and Schedule (Required):
Informal report documenting the soil characterization, geotechnical soil tests, and development of the LS-DYNA constitutive properties for the soil models. The soil models shall be provided in a LS-DYNA Material Type 5 format that allows for direct application to numerical model simulations. Required by: May 27, 2009.

2.3.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
The minimum acceptable level will be an informal report delivery upon completion of the soil constitutive model development. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and range of concepts that have potential for improved dynamic simulation of the soil/CEV impact.

2.4 Subtask 4: Develop constitutive properties for an LS-DYNA soil numerical model:
In this subtask, the Contractor shall perform laboratory tests on soil samples provided by LaRC to develop the required soil constitutive properties for the LS-DYNA soil and crushable foam model (Material Type 5) in the following configurations:

a) Two different densities; compacted and loose.

b) Two different levels of moisture.

These properties include: elastic shear modulus; unloading bulk modulus; shear failure surface parameters; and mean stress intercept of shear failure surface (see LS-DYNA Theory Manual, www.lstc.com/pdf/ls-dyna_theory_manual_2006.pdf). As a minimum the following geotechnical laboratory tests shall be performed to characterize the soils: grain size distribution; moisture content; minimum and maximum bulk density; grain density; hydrostatic compression; uniaxial strain; and triaxial compression. In development of these tests, appropriate stresses shall be applied to represent the soils in the range anticipated for the proposed passive landing system. In recent tests of the proposed passive landing system, the pressures ranged from 50 psig to 70 psig. From the geotechnical laboratory tests and in-situ data, the input parameters for the LS-DYNA soil models shall be developed by the Contractor. Where applicable, geotechnical soil tests shall be performed according to referenced testing standards.

2.4.1 Milestones (Optional): TBD

2.4.2 Deliverables and Schedule (Required):
Informal report documenting the soil characterization, geotechnical soil tests, and development of the LS-DYNA constitutive properties for the soil models. The soil models shall be provided in a LS-DYNA Material Type 5 format that allows for direct application to numerical model simulations. Required by: May 27, 2009.

2.4.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

The minimum acceptable level will be an informal report delivery upon completion of the soil constitutive model development. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and range of concepts that have potential for improved dynamic simulation of the soil/CEV impact.

*****End [R3] block addition*****

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to [R1]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: [R3]***TBD***

4. Other Essential Information: Site visits [R3>]***(if required)***[<R3] shall be coordinated by the NASA Langley Research Center.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): [R3]***TBD***

6. Period of Performance:

Planned start date:	[R3][R1]~~August 28, 2007~~ ***March 16, 2009***	Completion date:	[R1]~~December 15, 2007~~ [R2]~~April 30, 2008~~ [R3]~~May 16, 2008~~ [TD1]~~May 29, 2009~~ ***June 30, 2009***

7. NASA Task Management:

[R3>]**Technical Monitor (Required):** ***Robin D. Tutterow***

M/S: ***432*** Phone: 757-864-***7168***[<R3]

Other POC (Optional): R. Barry Bryant

M/S: 399 Phone: 757-864-7548

TASK ORDER NUMBER: 009E4-NNL07AM99T Revision: 1 Change: 0 Date: April 29, 2008

Title: **Aeronautics Systems Analysis Br. - Support, Studies and Model Dev - II**

1. Purpose, Objective, or Background (Optional)

An objective of this task is to provide advanced concepts vehicle design, 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 effort supports ASAB's main customers: the Fundamental Aeronautics Program (FAP), the Airspace Systems Program (ASP), and the Aviation Safety Program (AvSP). In the case of FAP support, tools and methods development is a task priority along with the conceptual design of advanced vehicle concepts.

Another objective of this task is to provide air space simulation and demand systems studies support to the ASAB. These air space simulation and demand studies are in support of the ASAB work in NASA's Air Space Program (ASP) in its mission to transform the air space system with the Next Generation Air Transportation System (NextGen) vision. The NextGen vision is to design and implement a transformed air space system that will be able to provide sufficient capacity to meet future passenger and flight demand both efficiently and safely. This effort will support ASAB's role to design, analyze, and conduct system integration studies of advanced concepts that will lead to success in the NextGen goal. This effort encompasses several focus areas that include ASAB in-house demand prediction capability of commercial airline passenger demand, General Aviation flight demand, and new on-demand air-taxi operations within the National Airspace System (NAS). Another focus area is the simulation of flight demand, with various models, to quantify the impacts of new NAS design concepts, vehicle concepts and infrastructure, and on-board aircraft technology advances. Other focus areas include safety assessments and automation versus human controller workload studies. This effort will support ASAB's pivotal role in the ability to quantify demand and develop, as well as, analyze new concepts that use combinations of network, vehicle and, technology enhancements that can lead to a future NAS that can meet the demands of the future.

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

Another objective of this task is to provide statistical analyses of aviation incidents and accidents to identify statistically significant trends 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 effort supports one ASAB's main customers: the Aviation Safety Program (AvSP).

*****End [R1] block addition*****

Revision 1 (04-29-2008) Adds requirements as new subtasks 2.5, 2.6, 2.7, 2.8, extends the period of performance ten months to January 31, 2009, clarifies safety and organization Subtask 2.n, and adds potential travel/training requirements and data rights clarification to Section 4 (see [R1] above and below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):
The Contractor shall support the ASAB prediction of demand generation for the passengers and flights in the future National Airspace system as part of work for the Airspace Systems Program (ASP) and the Joint Planning and Development Office (JPDO) by providing:

a) Updated Commercial Airline passenger demand studies for sensitivities in future cost, times savings and demographic projections to project a range of possible future enplanement and flight demands out to the implementation of NextGen.

b) Updated on-demand air-taxi passenger demand studies for sensitivities in future cost, times savings and demographic projections for Very Light Jets, as well other potential vehicles, to project a range of possible future enplanement and flight demands out to the implementation of NextGen.

c) General Aviation flight demand studies to include single engine, multi-engine and jet aircraft for both IFR and VFR flights in the NAS out to the implementation of NextGen.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):
a) Monthly status reports of results to date

b) Commercial airline demand studies with sensitivities that result from NextGen meeting its goals of time and efficiency. Due by: March 31, 2008

c) On-demand air-taxi demand studies with sensitivities that result from of NextGen meeting its goals of time and efficiency. Due by March 31, 2008

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds):
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. This includes briefings of results to ASP and JPDO colleagues. 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).

2.2(Requirement/subtask number two):
The Contractor shall support the ASAB airspace simulation capability in the future National Airspace system

as part of work for the Airspace Systems Program (ASP) and the Joint Planning and Development Office (JPDO) by providing:

a) Enhanced airspace simulation studies and support from state-of-the art airspace simulations such as ACES, and FACET.

b) The setup of flight schedules for commercial airlines, that match ASAB demand predictions, for hub and spoke operations, direct flight operations, operations at new commercial airports, operations with optimized fleet mixes.

c) The setup of flight schedules for on-demand air-taxi operations, that match ASAB demand predictions, for operations to and not to OEP airports, operations at new commercial airports, operations with optimized fleet mixes.

d) The setup of flight schedules for General Aviation operations, that match ASAB demand predictions, for operations into and not into OEP airports, operations at new commercial airports, and operations with optimized fleet mixes.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Enhanced Commercial Airline airspace simulations with sensitivities that result from of NextGen meeting its goals of time and efficiency. Due by: March 31, 2008

c) Enhanced On-demand air-taxi demand airspace simulations with sensitivities that result from of NextGen meeting its goals of time and efficiency. Due by: March 31, 2008

2.2.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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. This includes briefings of results to Airspace Systems Program and JPDO colleagues. 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).

2.3 (Requirement/subtask number three):

The Contractor shall support the Aviation Safety (AvSafe) Program, Airspace Systems Program (ASP) and the Joint Planning and Development Office (JPDO) by providing:

a) Updated Analyses of historical aviation accident, incident and or/ operational data to identify statistically significant trends related to AvSafe and Airspace Systems Program technologies using the ASAB's SAS software.

b) Enhanced Regression analyses of historical aviation accident, incident and or/ operational data to identify any possible overlooked issues in airspace systems and aviation safety using the ASAB's SAS software.

c) Enhanced Regression analyses of historical aviation accident, incident and or/ operational data to identify parameters for simulations of NextGen operational improvements using the ASAB's SAS software.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Report documenting the proposed methodology and data sources for regression analysis needed for simulations and/or models of Aviation Safety, Airspace Systems of JPDO Technologies.. Due by: December 31, 2007

c) Report containing descriptive statistics, summary and graphical representation of aviation safety or airspace systems related data regression analysis results. Due by: December 31, 2007

d) Report containing descriptive statistics, summary and graphical representation of aviation safety or airspace systems related statistical trend analysis results. Due by: December 31, 2007

2.3.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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. This includes briefings of results to Aviation Safety Program, Airspace Systems Program and JPDO colleagues. 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).

2.4 (Requirement/subtask number four):
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. The subtask requirements are as follows:

a. Structural Analysis and Design Support

- 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.
- Drawings, boundary conditions, and loading conditions will be provided by the NASA monitor.
- Finite element models will be reviewed by NASA technical monitor and the Contractor shall incorporate the comments into the structural model.

b. (NOC) Structural Mechanics Test and Analysis Support

The Contractor shall provide analysis and test support for research activities in structural mechanics and structural dynamics. Areas of support will include but are not limited to the following areas:

- Development of rapid analytic solutions for structural mechanics problems
- Structural response of composite aircraft, spacecraft, or space transportation systems with and without stiffness discontinuities
- Nonlinear structural analysis of built-up structural systems.
- Nonlinear dynamic analysis of metallic and composite aircraft and spacecraft.

Milestones (Optional):

Deliverables and Schedule (Required):

Deliverables:

- All the finite element models that have been created.
- The results (e.g., plots of deformed shape, stresses, and strains) of the finite element analyses.
- Monthly progress reports.
- A final report documenting the analysis results.

Schedule:

Drafts/revisions of contractor report due quarterly
All work is to be completed by December 31, 2007

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

2.5 (Requirement/subtask number five):
The Contractor shall support the Aviation Safety (AvSafe) Program and the Joint Planning and Development Office (JPDO) by providing:

a) Analyses of historical aviation accident, incident and or/ operational data to identify statistically significant trends related to AvSafe Program technologies using the ASAB's SAS software.

b) Regression analyses of historical aviation accident, incident and or/ operational data to identify any possible overlooked issues in aviation safety using the ASAB's SAS software.

c) SAS data and text mining of historical aviation accident, incident and or/ operational data to validate the output of ASAB safety related operations research (e.g., simulation, decision support) models.

2.5.1 Milestones (Optional):

2.5.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Status report containing causal factors, descriptive statistics, summary and graphical representation of loss of control and/or other aviation safety related statistical data trend analysis results. Due by: September 30, 2008

2.5.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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. This includes briefings of results to Aviation Safety Program and JPDO colleagues. 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).

2.6 (Requirement/subtask number six):
The Contractor shall support the ASAB prediction of demand generation for the passengers and flights in the future National Airspace system as part of work for the Airspace Systems Program (ASP) and the Joint Planning and Development Office (JPDO) by providing:

a) Commercial Airline passenger demand studies for sensitivities in future cost, times savings and demographic projections to project a range of possible future enplanement and flight demands out to the implementation of NextGen.

b) General Aviation flight demand studies to include single engine, multi-engine and jet aircraft for both IFR and VFR flights in the NAS out to the implementation of NextGen.

c) Studies of future NAS concepts that allow for demand prediction at new hubs, new commercial airports, new routes that bypass hubs, satellite airports within a TRACON and new fleets that are matched to optimize the schedule and business case on a given flight route.

2.6.1 Milestones (Optional):

2.6.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date

b) Updated commercial airline demand studies with sensitivities that result from NextGen meeting its goals of time and efficiency, as well as sensitivities to the increased cost of fuel. Due by: January 31, 2009

d) Updated General Aviation flight demand studies to include single engine, multi-engine and jet aircraft for both IFR and VFR flights in the NAS out to the implementation of NextGen. Due by: January 31, 2009

c) Demand studies for commercial airlines including the additions of new potential hubs, new commercial airports and satellite airports in TRACONS to model new NextGen concepts. Due by: January 31, 2009

2.6.3 Performance Metrics/Standard (Required - Meets, Exceeds):
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. This includes briefings of results to ASP and JPDO colleagues. 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).

2.7 (Requirement/subtask number seven):
The Contractor shall support the ASAB airspace simulation capability in the future National Airspace system as part of work for the Airspace Systems Program (ASP) and the Joint Planning and Development Office

(JPDO). Air simulation and impact studies will be conducted based upon TSAM demand capabilities and input parameter variation. Both the VAMS program and JPDO have claimed that the future NAS capability can be enhanced by the use of implementing secondary airports in the commercial airline network. This has been termed the Point-to-Point concept or the Biz-Shift concept. However, no quantitative studies have been conducted, because before TSAM there has been no methodology available to quantify the flights that could be diverted to these secondary airports. A study will be conducted calculating the demand for passengers and commercial flights at secondary airports around major hub airports. Then flight simulations will be conducted quantifying the benefits, or reductions in NAS and airport delays that may occur if this concept is realized. In addition, simulations will be conducted with TSAM demand sets showing airspace system impacts with different potential futures, such as the introduction of a national VLJ air taxi system or the realization of NextGen times savings benefits. Support will be provided by:

a) Airspace simulation studies and support from state-of-the art airspace simulations such as ACES, FACET, RAMS and ATSS.

b) The setup of flight schedules for commercial airlines, that match ASAB demand predictions, for hub and spoke operations, direct flight operations, operations at new commercial airports, operations with optimized fleet mixes.

c) The setup of flight schedules for on-demand air-taxi operations, that match ASAB demand predictions, for operations to and not to OEP airports, operations at new commercial airports, operations with optimized fleet mixes.

d) The setup of flight schedules for General Aviation operations, that match ASAB demand predictions, for operations into and not into OEP airports, operations at new commercial airports, and operations with optimized fleet mixes.

e) Simulations of the existing NAS and future NAS concepts for delay; capacity, en route sector loading, conflict detection and resolution that quantify metrics and examine concepts that maximize the performance of the metrics.

2.7.1 Milestones (Optional):

2. 7.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Airspace simulations studies for commercial airlines including the additions of new potential hubs, new commercial airports and satellite airports in TRACONS to model new NextGen concepts. Due by: January 31, 2009

2. 7.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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. This includes briefings of results to Airspace Systems Program and JPDO colleagues. 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).

2.8 (Requirement/subtask number eight):
The Contractor shall support the ASAB model development and enhancement as part of work for the Airspace Systems Program (ASP) and the Joint Planning and Development Office (JPDO) by providing

a) Enhancements and development of the Transportation Systems Analysis Model (TSAM) to meet future modeling needs of the Airspace Systems Program and the JPDO.

b) Enhancements and development of the airspace simulation suite of programs to include flight schedule generation, modeling of TRACONs, airports and en route sectors.

2. 8.1 Milestones (Optional):

2. 8.2 Deliverables and Schedule (Required):
a) TSAM cost model enhancements on the under utilized airline routes that are not included in the DB1B, but in the T100 Segment data. Due by: January 31, 2009

b) Enhancement of the ACES airspace simulation to output delay metrics for individual classes of aircraft, such as Business Jets, Very Light Jets and commercial airlines. Due by: January 31, 2009

2. 8.3 Performance Metrics/Standard (Required - Meets, Exceeds):
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. This includes briefings of results to Airspace Systems Program and JPDO colleagues. 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).

*****End [R1] block addition*****

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R1> ***support the requirements of this task order.*** <R1

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

A. Existing specialized analysis, processing, and/or design tools
B. Existing models, databases, geometry, data descriptions, and/or test data
C. Computer workstations and CPU time

4. Other Essential Information:

***** Begin R1 block clarification*****

The Contractor shall participate in appropriate technical conferences/short courses to maintain cognizance of new approaches and to refresh skills, as needed, to support the requirements of this task order as coordinated with the Technical Monitor.

NOTE: The Contractor shall place no restrictions on NASA's use or distribution of the models and/or codes produced under this task order. The models and/or codes shall only be used for performing the work under this contract and cannot be used for any other purpose nor distributed without the permission of NASA, Langley. The Contractor is required to sign a Software Usage Agreement.

***** End R1 block clarification*****

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: July 16, 2007 Completion date: R1~~March 31, 2008~~ ***January 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Jeffrey Viken

M/S: 442 Phone: 757-864-2875

TASK ORDER NUMBER: 061D3-NNL07AN01T Revision: 2 Change: 0 Date: April 22 2008

Title: Wind Tunnel Testing, Techniques, Data Analysis, and Documentation Support for Exploration

1. Purpose, Objective, or Background (Optional)

This work primarily supports Exploration Systems Mission Directorate (ESMD) and the LaRC Ares I Program Office efforts to document the aerodynamic characteristics of the Ares I launch vehicle. [TD1]Some work also supports the NASA Engineering and Safety Center (NESC) efforts to characterize and document the aerodynamic performance of an alternate Launch Abort System called the MLAS.

Revision 1 (11/6/07): Updates the anticipated NOC activity and updates the initial task order start date to September 24, 2007 (see [R1] below).
Technical Direction 1 (11/19/07): Adds specific description for NESC MLAS support (see [TD1] above and below).
Revision 2 (4/22/08): Extends the period of performance 12 months to July 31, 2009 in continuation of NASA's support at the same level or greater for the rest of FY 08 and FY 09 (see [R2] below).
Technical Direction 2 (2/3/09): Replaces Technical Monitor (see [TD2] Section 7, below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. See NOC designated item(s) and description below. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

2.1 (NOC) (Requirement/subtask number one):

The Contractor shall provide the following:

- Expertise in setting up and executing wind tunnel tests at transonic and supersonic speeds
- Expertise in wind tunnel test techniques, including flow visualization and propulsion effects
- Expertise in analysis of wind tunnel test data for applicability, accuracy, data trends, and quality
- Mentorship training in wind tunnel testing techniques for inexperienced branch members
- [TD1]MLAS: Expertise in overseeing the wind tunnel model design and fabrication process to ensure effective wind tunnel models are procured
- Expertise in evaluating/critiquing technical reports

The following NOC activity for ARES I is anticipated:

[R2>]***Note: It is anticipated that after the preliminary design review in July '08 another round of wind tunnel tests on an updated configuration.***[<R2]

Begin [R1] block update

Model	Tunnel	Speed Range	Type of Data	Test Duration	Test Start
1% ADAC-2B	BPWT	Transonic	F&M	5 days	November 26, 2007
1% ADAC-2B	ARC 11'	Transonic	Dynamic Damper & Wall Interference	5 days	December 10, 2007
1% ADAC-2B	BPWT	Transonic/Supersonic	Surface Pressures	15 days	January 14, 2008
0.65% First Stage Re-					

entry					
1% ADAC-2B	UPWT???	Supersonic	Surface Pressures	10 days???	Feb 2008?
1% ADAC-2B	NRC 5'	Transonic/Supersonic	F&M checkout test	2 days	January 2008?
X% Upper Stage	LaRC Mach 6	Mach 6	F&M	10 days???	???
1% ADAC-2B	LaRC NTF	Transonic	High Rn F&M	15 days?	March 2008?
1% ADAC-2B	LaRC NTF	Transonic	High Rn Surface Pressures	10 days?	March 2008?
TBD% Stage Separation	LaRC Mach 6? AEDC VKF B?	Mach 6	F&M	40-60 days	Configuration not defined yet
Requirements will include pre-test planning and post-test data analysis and documentation support. More tests will be added to the schedule as the Ares I and Ares-V programs develop					

***Begin TDT block ***

The following NOC activity for MLAS is anticipated:

Model	Tunnel	Speed Range	Type of Data	Test Duration	Test Start
MLAS F&M	TDT	Transonic	F&M	10 days	Feb 08
MLAS Parachute Test Development	TDT	Transonic	F&M	5 days	December 10, 2007
Requirements will include evaluation and selection of appropriate wind tunnel facility, oversight of wind tunnel model design and fabrication, pre-test planning and post-test data analysis and documentation support. More tests will may be added to the schedule as the Ares I and Ares-V programs develop MLAS data requirements					

***End TDT block ***

End R1 block update

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Specific deliverables, details, and/or completion dates for the work breakdown elements will be established by NOCs as indicated below.

DELIVERABLE	DATE
Informal report by project/venue for each NOC	5 days after completion
Monthly status report	Monthly

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets Standard: All wind tunnel support work meets government standards and is completed within schedule.

Exceeds Standard: All wind tunnel support work meets government standards and is ahead of schedule.

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Desk top computer, LaRCnet account

4. Other Essential Information:

Travel will be required per the following itinerary:

There is no known travel at this time; however, the Ares wind tunnel testing schedule may require the contractor to provide expertise at locations outside of LaRC.

5. Security Clearance:

6. Period of Performance:

Planned start date: [R1]September 24, 2007 Completion date: ~~July 31, 2008~~ ***July 31, 2009***

7. NASA Task Management:

[TD2]**Technical Monitor (Required):** ***William G. Tomek***

M/S: ***208*** Phone: 864-***7866***

MLAS POCs (Optional):

Laurence D. Leavitt (or David Schuster TBD)	M/S: 499	Phone: 864-3017
Steven Bauer	M/S: 499	Phone: 864-5946

TASK ORDER NUMBER: 062D3-NNL07AN02T Revision: 1 Change: 0 Date: March 27, 2008

Title: Uncertainty Analysis for the LaRC Compact Range Test Facility (CRTF)

1. Purpose, Objective, or Background

The radar cross-section (RCS) measurement community is continually looking for ways to improve measurement accuracy. For the last several years the community has adopted a national standard peer evaluation system through the RCS Range Certification Program. A requirement for this certification is the creation and use of a "Range Book" which has a specific format outlining a number of RCS range functions effecting data quality. A natural requirement and section in the range book that goes along with improvements in range performance is a well documented procedure for quantifying the uncertainties of the measurement. Research activities directed toward defining procedures for quantifying these uncertainties have also received recent attention due to efforts by the Air Force Research Laboratory (AFRL) to encourage RCS measurements facilities to document and report measurement uncertainties. This task is to produce an uncertainty analysis that documents the measurement uncertainty in the NASA Langley Compact Range Test Facility (CRTF).

Technical Direction 1 (01/15/08): Documents the extension of the period of performance 2 months to March 31, 2008 as authorized by the Contracting Officer in Mod 2 (see [TD1] below, Section 6).
Revision 1 (3/27/08): Extends the period of performance 1 month to April 30, 2008 and adjusts schedule to allow adequate time for scheduling the final results presentation without impacting cost and technical quality (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 The Contractor shall produce an uncertainty analysis report, and supporting documentation, that will quantify and document the RCS measurement uncertainties for NASA Langley Research Center's CRTF. Specifically the contractor shall conduct the analysis for frequency bands of 2 to 18 GHz encompassing RF bands S, C, X, and Ku. The calibration cylinders of interest for this analysis include the AFRL Cylinder Standards: 450, 750, and 900.

2.1.1 Deliverables and Schedule:

Draft Uncertainty Analysis Report	[R1] ~~15 Jan 2008~~ ***15 April 2008***
Final Uncertainty Analysis Report	[R1] ~~30 Jan 2008~~ ***30 April 2008***
Supporting Documentation	[R1] ~~30 Jan 2008~~ ***30 April 2008***

2.1.2 Performance Metrics/Standards

Exceeds: Product delivered ahead of schedule
Meets: Product delivered on schedule

2.n Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: NASA Langley Research Center, Electromagnetic and Sensors Branch staff will provide measurement data for completion of the RCS Uncertainty Analysis. All parameters will be of values typical for normal radar operation. As a rule, the frequency band width and step size, and number of integrations will be the same for each measurement. The frequency step size for the frequency bands shall be 17 MHz. In addition, all "target" measurements will be accompanied by calibration measurements. This includes a target background, calibration (reference) target, and calibration target background; where the configurations of the calibration cylinders allow. These "raw" measurements and any laboratory notes and digital photos of the specific measurements will be provided to the contractor in ascii or some other previously agreed to format.

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): None

6. Period of Performance:

Planned start date: 25 Sep 07 Completion date: TD1 ~~30 Jan 08~~
R1 ~~31 March 08~~
30 April 08

7. NASA Task Management:

Technical Monitor (Required): Dion Fralick
M/S: 490 Phone: 757-864-8362

Other POC (Optional): Erik Vedeler
M/S: 490 Phone: 757-864-1825

TASK ORDER NUMBER: 063D3-NNL07AN03T Revision: 0 Change: 0 Date: September 21, 2007.

Title: Transonic Wind Tunnel Test of 0.01-Scale Ares I Configuration

1. Purpose, Objective, or Background (Optional)

The Ares I Launch Vehicle is part of NASA's mission to develop a cost-effective, next-generation space transportation system. The system will, in keeping with the Vision for Space Exploration, safely and reliably take human explorers to the Moon, Mars and on into the solar system.

The Ares I project is preparing an aerodynamic database that characterizes the vehicle throughout the speed regime of ascent flight where aerodynamic effects are important. This speed regime begins at liftoff and continues through first-stage separation or about Mach 6. The aerodynamic force and moment database will be used to determine the Ares I performance, stability & control effectiveness, and structural stability.

NASA Langley Research Center will utilize a transonic wind tunnel to support the Ares I project. To support the assessment of the current Ares I configuration, the data to develop the aerodynamic database is required over the ascent Mach range. A 0.01-scale (~ 38" long) wind tunnel model has been built to test at NASA LaRC's Unitary Plan Wind Tunnel, for the Mach range 1.5-4.6. Data is required at the lower speeds for the initial phase of ascent.

Technical Direction 1 (10/17/07): Provides clarifications and updated requirements (see [TD1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

A transonic wind tunnel test covering the Mach range [TD1]***0.5***-1.6 providing data for the early ascent phase for Ares I flight in required. A facility that allows the use of the existing model, sting, and balance hardware is also required. The test matrix is attached.

2.1 (Requirement/subtask number one):

The Contractor shall provide hardware requirements for testing in a transonic wind tunnel. The Contractor shall provide the wind tunnel facility and personnel to install the model hardware and perform the test matrix and shall provide all data reduction set-up, transmittals, data files and verification. The Contractor shall perform check-loadings and angle-of-attack verification, wind off zeros, and weight tare procedures. Based on the test matrix, the Contractor shall provide flow angularity evaluations. The Contractor shall provide preliminary test data to LaRC on-site engineers for review during the test. Final data shall be provided two (2) weeks after completion of the test matrix to LaRC. The Contractor shall disassemble the model and box and ship the model to LaRC upon completion of the test.

The Contractor shall perform the following requirements:

a. Provide LaRC personnel model/sting requirements for entry in the transonic wind tunnel.
b. Provide all data set-up, transmittals, data files and verification.
c. Provide angle-of-attack verification, wind-off zeros, and weight tare procedures.
d. Install model hardware in the tunnel.
e. Perform wind tunnel test during [TD1]***November 26-30, 2007***, per test matrix for the force & moment test.
f. Deliver preliminary test data during test for review by LaRC on-site engineers.
g. Deliver finalized test data with 2 weeks following test completion.
h. Removal and disassembly of model and box and ship model to LaRC upon completion of test.

2.1.1 Milestones (Optional): Wind tunnel test during [TD1]***November 26-30, 2007***

a. Provide model hardware requirements to LaRC - Week of Nov [TD1]***12th***
b. Provide all data set-up, transmittals, data files and verification - Week of Nov [TD1]***12th***
c. Provide angle-of-attack verification, wind-off zeros, and weight tare procedures -Week of Nov

TD1 ***19th***

*****Begin TD1 block clarification/update*****

2.1.2 Deliverables and Approximate Schedule (Required):

a. NASA will deliver model hardware to facility 11/16/07

b. Contractor shall install model hardware 11/16/07

c. Contractor shall perform test per test matrix 11/26/07

d. Contractor shall deliver preliminary test data 11/30/07

e. Contractor shall deliver final test data 12/14/07

f. Contractor shall disassemble model, box, and ship to LaRC 12/3/07

*****End TD1 block clarification/update*****

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets:

a. All milestone dates and deliverable dates are met.

b. Test matrix is completed on time.

Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent schedule slippage or bad test data.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

a. Model, sting, and balance hardware

b. NASA plans to provide TD1 ***engineering*** support for the test program. This support will include NASA personnel participating in technical reviews to support the test entry; provide test engineering support during the test; and provide the model, the sting, and adapter hardware. LaRC engineers will be present during the test to review data.

4. Other Essential Information:

TD1 ***The Contractor shall fully coordinate staffing and wind tunnel selection, scheduling, and data accuracy issues with the Technical Monitor.***

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

All technical data generated shall comply with all applicable export and ITAR requirements, NASA policies, Langley management system procedures and any established international agreements required by NASA

policies. TD1 ***All data shall be submitted directly to NASA Technical Monitor***

6. Period of Performance:

Planned start date: TD1 ***October 31, 2007*** Completion date: December 31, 2007

7. NASA Task Management:

Technical Monitor (Required): William G. Tomek

M/S: 499 Phone: 757-864-7866

Other POC (Optional): Darlene C. Pokora

M/S: 208 Phone: 757-864-7511

Test Matrix -- CLV DAC-2B 1% Force/Moment Model

Test Objectives	
1	Quantify DAC-2B Configuration with all protuberances
2	Quantify DAC-2B Configuration with all protuberances except BDM's
3	Quantify DAC-2B Configuration with all protuberances but BDM's on frustum
4	Quantify DAC-2B Configuration with no protuberances
5	Conduct sufficient repeat runs to establish reproducibility
6	Determine tunnel upflow
7	Quantify boundary layer trip effects

Alpha/Phi Schedules	
A	-8 to 8 deg (3 deg/s)
B	-3 to 3 deg (3 deg/s)
E1	0° to 180° sweep 30 deg/s
E2	0° to -180° sweep 30 deg/s

Configurations

1 Configuration with all protuberances (baseline .003" disc configuration)
2 Configuration with all protuberances (full grit configuration)
3 Configuration with all protuberances (no grit configuration/transition free)
4 Configuration with no protuberances (baseline .003" disc configuration)
5 Configuration with no protuberances and no LAS nozzles (full grit configuration)
6 Configuration with no protuberances and no LAS nozzles (no grit configuration/transition free)

TASK ORDER NUMBER: 063D3-NNL07AN03T Revision: 0 Change: 0 Date: September 21, 2007.

Title: Transonic Wind Tunnel Test of 0.01-Scale Ares I Configuration

Test Objective	Config	Pitch	Alpha	Beta	Phi	0.50	0.80	0.90	0.95	1.05	1.10	1.20	1.40	1.6	1.8
6	1	Vary	B	0°	180°	x	x	x	x	x	x	x	x	x	x
0	1	Vary	A	0°	0°	0 q polar									
0	1	4°	Vary	Vary	E1	0 q polar									
0	1	4°	Vary	Vary	E2	0 q polar									
0	1	8°	Vary	Vary	E1	0 q polar									
0	1	8°	Vary	Vary	E2	0 q polar									
1	1	Vary	A	0°	0°	x	x	x	x	x	x	x	x	x	x
5	1, repeat	Vary	A	0°	0°	x	x	x	x	x	x	x	x	x	x
1	1	0°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	1	0°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
1	1	4°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	1	4°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
1	1	7°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	1	7°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
1	1	8°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	1	8°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
5	1,repeat	8°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
5	1,repeat	8°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
7	2	Vary	A	0°	0°			x				x		x	
7	2	8°	Vary	Vary	E1			x				x		x	
7	2	8°	Vary	Vary	E2			x				x		x	
7	3	Vary	A	0°	0°			x				x		x	
7	3	8°	Vary	Vary	E1			x				x		x	
7	3	8°	Vary	Vary	E2			x				x		x	
1	4	Vary	A	0°	0°	x	x	x	x	x	x	x	x	x	x
5	4, repeat	Vary	A	0°	0°	x	x	x	x	x	x	x	x	x	x
1	4	0°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	4	0°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
1	4	4°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	4	4°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
1	4	4°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	4	7°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
1	4	7°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
1	4	8°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
5	4,repeat	8°	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x
5	4,repeat	8°	Vary	Vary	E2	x	x	x	x	x	x	x	x	x	x
7	5	Vary	A	0°	0°			x				x		x	
7	5	8°	Vary	Vary	E1			x				x		x	
7	5	8°	Vary	Vary	E2			x				x		x	
7	6	Vary	A	0°	0°			x				x		x	
7	6	8°	Vary	Vary	E1			x				x		x	
7	6	8°	Vary	Vary	E2			x				x		x	

TASK ORDER NUMBER: 001B6-NNL08AM01T Revision: 0 Change: 0 Date: September 26, 2007

Title: **Technical and Programmatic Analysis for OCFO**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01SA)

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

There are approximately five projects/proposals that will require some level of review or cost analysis each year by the OCFO Cost Analysis Officer. The Contractor will be expected to provide appropriate technical experts to assist the OCFO Cost Analysis Officer in reviewing, evaluating, and validating project/proposal 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; Parametric Cost Estimating; and other associated disciplines.

Technical Direction 1 (01/04/08): updates the initial task order start date to January 2, 2008 as issued by the Contracting Officer 01/02/08 (see [TD1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. NASA will provide clarification of specific analysis requirements as they become defined. See NOC designated item(s) and description below. **Note: It is anticipated that 0.5 WYE with periodic surges will be needed in support of this task order.**

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

Deliverables

The Consultant Database delivered to the Technical Monitor on a monthly basis.

Metrics

MEETS if database is received on a monthly basis within one week of month end.
EXCEEDS if database is delivered on a bi-weekly basis.

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. 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.

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.

C. (NOC) Technical and Programmatic Analysis

The Contractor's technical expert(s) shall provide results of technical and programmatic analysis of each required project/proposal. The technical expert(s) shall develop a detailed plan to perform the analysis. The technical expert(s) shall brief the OCFO Cost Analysis Officer weekly on the analysis to date. The primary product for each analysis shall be a Final Report summarizing the technical, cost, schedule, and risk analyses conducted; a cost estimate; and a risk assessment. The schedule for delivery of the Final Report, and a schedule of meetings to be attended by the technical expert(s), shall be developed by the technical expert(s) in cooperation with the OCFO Cost Analysis Officer.

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

Deliverables

The technical expert(s) shall deliver the Final Report for each project/proposal 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
- Detailed cost estimate

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
- Reconciliation with project/proposal cost estimate

2.n. Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: None

4. Other Essential Information: None

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements.

6. Period of Performance:

Planned start date: TD1 ***January 2, 2008*** Completion date: December 31, 2008

7. NASA Task Management:

Technical Monitor (Required): Debra H. Schroeder
M/S: 104 Phone: (757) 864-6101

Other POC (Optional): Cecelia R. Fletcher
M/S: 937 Phone: (757) 864-2339

TASK ORDER NUMBER: 014D2-NNL08AM02T Revision: 2 Change: 0 Date: April 9, 2009

Title: Exploration and Science Mechanical Development Support for SED

1. Purpose, Objective, or Background (Optional)

The Systems Engineering Directorate has the responsibility to assist NASA Projects with the Mechanical engineering design, structural analysis, thermal analysis, ground vibration testing, electromagnetic interference testing, assembly and integration and systems engineering for the development of systems to support a broad spectrum of activities that include but not limited to feasibility studies, proposal development, laboratory systems, and flight systems in support of the NASA mission for exploration and ongoing atmospheric studies in conformance to responsibilities stated in the LaRC Organizational Unit Plan LMS-OUP-D2, responsibilities.

This task will provide engineering services to support ongoing engineering design, development and testing activities under the functional responsibility of org the Systems Engineering Directorate.

Technical Direction 1 (11/8/07): Adds various clarifying details that were previously omitted and updates the planned start date (see [TD1] below).

Revision 1 (9/19/08): Extends the period of performance 6.5 months to July 31, 2009 in continuation of NASA's support (see [R1] below, Section 6).

Revision 2 (4/9/09): Extends the period of performance 5 months to December 31, 2009 in continuation of NASA's support (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract Paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATION (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

Note: All engineering tasks shall be performed with the use of standard CAD/CAE software tools as described in section 3 of this SOW.

2.1 Engineering services for mechanical engineering design and development of test and flight systems for the Exploration, Science and Aeronautics Programs (Subtask 1)

The Contractor shall provide junior, midlevel [TD1] and/or senior mechanical design engineering expertise [TD1] as clarified by NOC(s) for design and development, and delivery of test and flight hardware to support project milestones. The Contractor shall be responsible for developing mechanical system designs, three dimensional CAD/CAE models, and detail design drawings for manufacturing that are compliant with ASME 14.5. The Contractor shall also develop and produce technical specifications and procedures for assembly, integration and testing of project hardware to produce certification of compliance of delivered end item with established performance requirements.

2.1.1 The Contractor shall provide engineering design and development of hardware to meet project requirements to include the following:

1. Design-for-fabrication of hardware to meet project requirements.
2. Engineering and sizing of load-critical components to assure parts meet structural, vibration, thermal and material compatibility requirements are met.
3. Modeling of engineering design and detail drawings with the use of PTC Pro-Engineer CAD software.
4. Structural analysis via hand calculations and component finite element analysis required for

the proper sizing of designed components to meet hardware performance requirements.

Deliverables:

Report that contains, [TD1]as applicable, number/nature of contacts (team collaboration), recommendations resulting in quality of product under production, savings to the government resulting from advice (cost and/or schedule), or benefit to the engineering process. The report shall also provide recommendations to improve engineering processes, including training, tools, tool configuration, and any other engineering design development process related to the delivery of engineering products.

CAD models of associated design, hand calculations or results from component finite element analysis. Engineering drawings ready for signature by Branch level authority. Contractor signature of the review block will certify drawing correctness for drafting standards, completeness of technical information and specifications needed for the production of desired product, and compatibility of specifications to assure proper compatibility to lower and upper level assembly or processes.

Due Date:

Ongoing deliverable. Deliverable due not longer than two days from submission of drawing for review. Deliverable for this item is defined as return of drawing with feedback for correction by author or delivery of drawings for signature by Branch Authority.

2.1.2 The Contractor shall develop and produce approved procedures to support the successful accomplishment of project milestones. All Procedures shall be filed with the project configuration manager. The Contractor shall ensure all needed signatures of approval are collected before the activity controlled by such procedures can take place.

The Contractor shall develop approved test procedures for the successful verification that tested hardware components, sub-systems or systems comply with all performance requirement. The Contractor shall also provide modifications as needed to accommodate and document alternate test conditions.

The Contractor shall develop assembly procedures as required for the production of assembly of components into sub-assemblies and up to the production of full assemblies as needed by the project. Operations and processing procedures are also within the scope of this sub-element.

Deliverables:

Approved procedures completed and approved by project management in time to proceed with procedure controlled activity per project schedules.

Monthly report of engineering documentation activity. Report shall contain status of

procedures under development and status of activities controlled by approved procedures authored by the Contractor.

Due Date: Ongoing deliverable [TD1] with specific dates established in the NOC(s).

2.1.3 Performance Metrics/Standards

MEETS:

Final engineering design is free of engineering specification discrepancies when delivered to fabrication.

Final analyses and CAD models meet project requirements and require minor corrections.

100% of procedures completed, approved, and distributed in time for implementation of the planned procedure-controlled activity per project schedules.

EXCEEDS:

Design author receives feedback that results in significant schedule or cost savings for production of final engineering products specified by engineering drawings. Estimates of cost/schedules benefits to the government shall be certified by the gaining organization/engineering product author.

Final analyses and CAD models require no corrections and provide quantifiable savings to the government during flight system development

Approved procedures authored by the Contractor result in significant benefit to the government over prior planned procedure-controlled activities. Quantification of the benefit include enhancement of safety to personnel and infrastructure, reduced cost and time for implementation, enhanced quality of engineering data collection for post test analyses.

2.2. Exploration Flight Systems Engineering (Subtask 2):

2.2.1. The Contractor shall define, derive, track and support development and verification for systems requirements and associated interfaces needed for successful delivery of engineering products in support of the project development activity.

Systems engineering support shall be provided for flight, ground-test, prototype, and ground support equipment including the development of System Engineering Management, Configuration Management, and Validation & Verification Plans.

Additional support includes all associated documentation required for project implementation. The Contractor shall define interfaces and assure compatibility between major subsystems, including, mechanical structural/thermal, mechanisms, power, data, avionics, and data systems. The Contractor shall develop all deliverables in accordance with negotiated project standards.

The Contractor shall support engineering reviews by providing design and engineering data to generate presentation slides for reviews.

Deliverables:

Project documentation and requirements for development of prototype, ground, test, flight, and ground support equipment as negotiated with the project office.

Top level requirements with linkages to derived requirements with traceability to engineering products such as detail design drawings, analyses results, and project documentation as negotiated with project.

Development of Validation & Verification Matrix identifying how each of the projects requirements will be accomplished.

Reports and presentation required to support associated project reviews.

[TD1]Due Date: Ongoing deliverable with specific dates established in the NOC(s).

2.2.2. Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date; Exceeds Requirements will be defined as delivery one week or more prior to due date.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The government will provide access to source codes needed for the accomplishment of the assigned tasks. The Contractor shall be responsible to provide computer resources of enough capacity to accomplish the assigned tasks. Contractor computer resources shall be capable of running Mechanical Systems Branch

standard source code clients that include PTC Pro-engineer, Pro-mechanica, and Pro-PDM; Collier Technology HypersizerPro; MSC NASTRAN, and PATRAN; MathLab; and Mathcad. Computer models Shall vary from very small to very large, including but not limited to computer models of full vehicle assemblies

4. Other Essential Information:

5. Security Clearance:

None Needed

6. Period of Performance:

Planned start date: TD1 11/13/07 Completion date: R1 ~~01/15/09~~ R2 ~~07/31/09~~ ***12/31/09***

7. NASA Task Management:

Technical Monitor (Required): William M. Berrios

M/S: 432 Phone: 864-7183

Other POC (Optional): Drew J. Hope

M/S: 432 Phone: 864-7278

TASK ORDER NUMBER: 015D2-NNL08AM03T Revision: 2 Change: 0 Date: July 25, 2008

Title: Exploration and Science Structural Analysis and Test Support

1. Purpose, Objective, or Background (Optional)

The Structural and Thermal Systems Branch (STSB) of the Systems Engineering Directorate is responsible for the structural and thermal analysis and test support of advanced aerospace flight vehicles and the test articles used to evaluate and qualify these vehicles. The analyses and tests range from manned and unmanned aircraft and space vehicles to individual system components, to test articles, facilities, and testing arrangements supporting these vehicles and their subsystems. The branch utilizes high-fidelity structural and thermal analysis tools employing finite element modeling and analysis techniques, as well as simpler handbook computations to complete these tasks. A broad spectrum of activities that include feasibility studies; proposal development; and the development of laboratory systems, flight systems, and others in support of the NASA mission for exploration and ongoing atmospheric studies are conducted in conformance to responsibilities stated in the LaRC Organizational Unit Plan LMS-OUP-D2, responsibilities. A combination of skilled Civil Servant and contractor workforce is used to complete these analyses, and this task addresses the requirements for skilled contractor personnel to perform the analysis and test-support tasks under the functional responsibility of the Structural and Thermal Systems Branch.

All engineering design tasks shall be performed with the use of standard engineering analysis software tools as described in section 3 of this SOW.

Technical Direction 1 (11/9/07): Updates the initial task order start date to November 13, 2007 (see [TD1] below).
Revision 1 (12/13/07): Updates and/or notes 1) period of performance, 2) varying WYE level, and 3) anticipated travel requirements. The need for reference to these requirements became evident in N001, dated 11/26/07 (see [R1] below).
Revision 2 (7/25/08): Extends the period of performance 7 months to July 31, 2009 in continuation of NASA's support (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract Paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATION (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

The scope of this SOW is to provide structural analysis and test support for exploration, science, and aeronautics projects in the STSB. STSB has leadership and/or significant roles for the structural analysis discpline area in several Exploration, Science, and Aeronautics Projects. These projects currently include Ares I-X (both integrated stack structures and the Command Module/Launch Abort System (CM/LAS) flight test article (FTA)), Pad Abort 1 (PA-1) FTA, Ares I Upperstage, CEV TPS Advanced Development Project, Launch Abort System (LAS), Orion Vehicle Integration Office (OVIO) integrated structures, and the Mars Science Laboratory (MSL) Entry Descent and Landing Instrumentation (MEDLI) project. In addition, STSB is frequently required to provide support to numerous projects in a "consultant" mode and is called on to provide support to the Integrated Design Center (IDC). The range of structural analyses may include stress, fatigue & fracture, stability, loads, random vibration, or transient structural response analyses. A mixture of finite element analysis as well as handbook analysis may be required. During the period of performance, the Contractor shall support structural analysis and/or testing tasks as requested. The Government will define specific requirements for each requested

activity through NOC's. These requirements will include the schedule and expected deliverables (including format).

2.1. Structural Analysis And Test Support For Exploration, Science, And Aeronautics Projects (Subtask 1):

2.1.1 The Contractor shall provide structural analysis and test support for Exploration, Science, and Aeronautics Projects in STSB. The range of structural analyses may include stress, fatigue & fracture, stability, loads, random vibration, or transient structural response analyses. A mixture of finite element analysis as well as handbook analysis may be required. Structural tests supported may include static or dynamic loadings as well as thermal-structural tests. The generalized deliverables are described in Section 2.2.2 below.

2.2.2 Deliverables

2.2.2.1 Analysis models in electronic format, including model file, applicable results files, and any subsidiary files necessary to run the model.

2.2.2.2 Analysis reports documenting analysis work, model development, assumptions, requirements, cases run, results, issues and solutions.

2.2.2.3 Charts, tables, documents and electronic media documenting Contractor methods and results.

2.2.2.4 Source code (such as Fortran, C++ or Visual Basic) developed to automate running a model, analyzing results, or to support any STSB task.

2.2.2.5 Charts, tables, documents, photographs, and other data required for documentation of the results of all thermal tests supported.

2.2.3 Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date (NOC); Exceeds Requirements will be defined as delivery one week or more prior to due date (NOC).

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The government will provide access to source and executable codes needed for the accomplishment of the assigned tasks. The Contractor shall be responsible to provide computer resources of enough capacity to accomplish the assigned tasks. Contractor computer resources shall be capable of running STSB standard

clients that include PTC Pro-engineer, Pro-mechanica, and Pro-PDM; Collier Technology HypersizerPro; MSC NASTRAN, PATRAN, and Patran Thermal; Intel C++ and Fortran compilers; AutoDesk Mechanical Desktop; C&R Thermal Desktop; MathLab; and Mathcad. Computer models shall vary from very small to very large, including but not limited to computer models of full vehicle assemblies.

4. Other Essential Information:

Begin [R1] block addition

The scope of this activity is expected to require a varying number of WYEs and travel to be determined from the NOCs submitted by NASA.

Begin [R1] block addition

5. Security Clearance:

None Needed

6. Period of Performance:

Planned start date: [TD1] 11/13/2007 Completion date: [R1] ~~11/30/2008~~ [R2] ~~12/31/2008~~ ***7/31/2009***

7. NASA Task Management:

Technical Monitor (Required): **David M. McGowan**
M/S: 431 Phone: 4-4916

Other POC (Optional): **Scott A. Hill**
M/S: 431 Phone: 4-7029

06403-NNL08AM04T

Statement of Work
Wind Tunnel Transonic Test for the CLV Project

1.0 Background

The Crew Launch Vehicle is part of NASA's mission to develop a cost-effective, next-generation space transportation system. The system will, in keeping with the Vision for Space Exploration, safely and reliably take human explorers to the Moon, Mars and on into the solar system.

The CLV project is preparing an aerodynamic database that characterizes the vehicle throughout the speed regime of ascent flight where aerodynamic effects are important. This speed regime begins at liftoff and continues through first-stage separation or about Mach 6. The aerodynamic database will be used to determine the CLV performance, stability & control effectiveness, and structural stability. Verification of the loads database produced using Computational Fluid Dynamics (CFD) is needed through comparison with wind tunnel data from a pressure instrumental model.

2.0 Scope of Work

The contractor shall utilize a Polysonic wind tunnel to support the CLV project. To support the assessment of the current CLV configuration, the data to develop the aerodynamic database is required over the ascent Mach range. A 0.01-scale (~ 38" long) wind tunnel model has been built to test at the Polysonic Wind Tunnel facility, for the Mach range 0.5-4.5.

The Polysonic wind tunnel test covers the Mach range 0.5-4.5 providing data for the early ascent phase for CLV flight. This facility allows the use of the existing model, sting, and balance hardware. The test matrix is attached.

3.0 Technical Requirements

3.1 The contractor shall provide hardware requirements for testing in the Polysonic wind tunnel. The contractor shall provide the wind tunnel facility and personnel to install the model hardware and perform the test matrix and shall provide all data reduction set-up, transmittals, data files and verification. The contractor shall perform angle-of-attack verification procedures. Based on the test matrix, the contractor shall provide flow angularity evaluations. The contractor shall provide preliminary test data to LaRC on-site engineers for review during the test. Final data shall be provided two (2) weeks after completion of the test matrix to LaRC. Boeing shall disassemble the model and box and ship the model to LaRC upon completion of the test.

NASA plans to provide for support of the test program. This support shall include NASA personnel participating in technical reviews to support the test

entry, provide test engineering support during the test, the model, the sting, and adapter hardware. LaRC engineers shall be present during the test to review data.

3.2 The contractor shall:

3.2.1 Provide LaRC personnel model/sting requirements for entry in the Polysonic Wind Tunnel.

3.2.2 Provide all data set-up, transmittals, data files and verification.

3.2.3 Provide angle-of-attack calibrations and verifications

3.2.4 Install model hardware in the tunnel.

3.2.5 Perform wind tunnel test starting the week of January 14, 2008 per test matrix.

3.2.6 Deliver preliminary test data during test for review by LaRC on-site engineers.

3.2.7 Deliver finalized test data with 2 weeks following test completion.

3.2.8 Removal and disassembly of model and box and ship model to LaRC upon completion of test.

4.0 EXPORT CONTROL REQUIREMENTS

4.1 All technical data generated shall comply with all applicable export and ITAR requirements, NASA policies, Langley management system procedures and any established international agreements required by NASA policies.

5.0 MILESTONE SCHEDULE

Milestone	SOW Reference	Deliverable	Date
Provide model hardware requirements to LaRC	3.2.1		Week of 1/7/08
Provide all data set-up, transmittals, data files and verification	3.2.3		Week of 1/7/08
Provide angle-of-attack calibration and verification procedures	3.2.4		Week of 1/7/08
Deliver model hardware to Polysonic	3.2.5		1/7/08
Install model hardware	3.2.5		1/7/08
Perform test per test matrix	3.2.6		1/14/08

Deliver preliminary test data	3.2.7	2/17/08
Deliver final test data	3.2.8	3/1/08
Disassemble model, box, and ship to LaRC	3.2.9	2/17/08

Boeing PSWT Pressure Test -- DAC-2B (A103) 1% CLV Model

Test Objectives	
1	Quantify DAC-2B (A103) Configuration with no protuberances
2	Quantify DAC-2B (A103) Configuration with all protuberances
3	Conduct sufficient repeat runs to establish reproducibility
4	Determine tunnel upflow
5	Determine effect of grit

Alpha/Phi Schedules	
A	0, 2, 4,7 – (4 alphas)
B	-3, -2,-1,-.5,0,.5,1,2,3 – (9 alphas)
E1	0_i to 180_i @ every 15_i- (13 phis)

Configurations

1 DAC-2B (A103) Configuration with all protuberances and baseline grit
2 DAC-2B (A103) Configuration with all protuberances with heavy grit
3 DAC-2B (A103) Configuration with all protuberances with no grit
4 DAC-2B (A103) Configuration with no protuberances

Test Objective	Config	Pitch	Alpha	Beta	Phi	0.50	0.70	0.80	0.90	0.95	1.05	1.10	1.20	1.30	1.40	1.50	1.6	1.8	2	2.5	3	3.5	4	4.5
4	4	Vary	B	0_i	0_i	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1	4	0_i	0_i	0_i	E1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1	4	2_i	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1	4	4_i	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1	4	7_i	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	4	0_i	Vary	0_i	E1																			
3	4	2_i	Vary	Vary	E1		x		x	x	x	x		x			x		x		x		x	
3	4	4_i	Vary	Vary	E1																			
3	4	7_i	Vary	Vary	E1		x		x	x	x	x		x			x		x		x		x	
2	1	0_i	0_i	0_i	E1																			
2	1	2_i	Vary	Vary	E1																			
2	1	4_i	Vary	Vary	E1																			
2	1	7_i	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	4	0_i	0_i	0_i	E1																			
3	4	2_i	Vary	Vary	E1		x		x	x	x	x		x			x		x		x		x	
3	4	4_i	Vary	Vary	E1																			
3	4	7_i	Vary	Vary	E1		x		x	x	x	x		x			x		x		x		x	
2	1	7_i	Vary	Vary	E1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	2	2_i	Vary	Vary	E1				x				x			x			x	x			x	
5	2	7_i	Vary	Vary	E1				x				x			x			x	x			x	
5	3	2_i	Vary	Vary	E1				x				x			x			x	x			x	
5	3	7_i	Vary	Vary	E1				x				x			x			x	x			x	
					Re/ft	3.2	5.5	6	6.9	7.7	5.9	7	7	7	6.9	6.8	6.6	6	6	6	6	10	10	10

1. Purpose, Objective, or Background (Optional)

The Dynamic Systems and Control Branch (DSCB) of the Research and Technology Directorate (RTD) is responsible for advancing the capabilities of aerospace vehicles through the research, development and application of guidance, control and modeling technologies. (Subtask 2.1)

The mission of the Flight Dynamics Branch (FDB) of RTD is to advance knowledge and technology for the prediction of flight dynamic characteristics, identify and provide solutions to difficult flight dynamics problems, and support development of new flight vehicle concepts. (Subtask 2.2)

The Structural Mechanics and Concepts Branch (SMCB) of the RTD has the responsibility to assist NASA Projects with thermal, structural, and thermal-structural design, analysis and testing required to develop advanced technologies in support of the NASA missions for exploration and ongoing aeronautics research. (Subtask 2.3)

The Durability, Damage Tolerance and Reliability Branch (DDTRB) of the RTD is responsible for the advancement of the state of the art in the areas of computational, analytical and experimental research and development in basic structural behavior and to develop efficient, physics-based analytical and computational methods to enable design and analysis of advanced materials and structures for aerospace applications. (Subtask 2.4)

Structural Dynamics Branch (SDB) is currently performing impact dynamics research for several programs of national importance, including the President's program to send astronauts back to the moon and onward to Mars. In particular, an advanced development program to investigate the best approach to safely land a scaled up and modernized Apollo-like capsule called Orion is now underway using Langley's Landing and Impact Research (LandIR) Facility, a 240-ft high gantry structure. (Subtask 2.5)

The purpose of Subtask 2.6 is to develop processing technology and conduct mechanical testing, microstructural analyses and provide scientific consultation on advanced materials systems. 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 materials for subsequent processing and/or analysis. The majority of materials to be processed and analyzed include aluminum alloys, titanium alloys and intermetallics, nickel alloys and intermetallics, shape memory alloys, continuous and discontinuous reinforced metal matrix composites, polymeric and ceramic based material systems

The scope of this work is to provide short-term surge support for critical project milestones in exploration, science, and aeronautics for programs such as Ares-I and Ares-I-X as described in TD3> ***but not limited to*** <TD3 the subtasks below.

Technical Direction 1 (01/04/08): updates the initial task order start date to January 2, 2008 as issued by the Contracting Officer 01/02/08 (see TD1 below).
Revision 1 (2/19/08): Extends the period of performance 7 months to July 31, 2009 in continuation of NASA's anticipated support requirements (see R1 below, Section 6).
Revision 2 (8/18/08): Extends the period of performance 5 months to December 31, 2009 in continuation of NASA's anticipated support requirements (see R2 below, Section 6).
Technical Direction 2 (11/19/08): Adds clarifying note that work required may cross NASA organizational boundaries (see TD2 below).

Technical Direction 3 (4/21/09): Further clarifies the organizationally aligned requirements (see TD3 above and below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) to this task order. The Government will clarify requirements for each requested subtask activity through NOC's. These requirements will include the specific schedule, expected deliverables (including format), and other clarifications as needed. See NOC designated item(s) and description below.

TD2>Note: In some cases the work required may cross organizational boundaries within NASA as LaRC RTD researchers are selected to manage the work by virtue of their expertise.<TD2 TD3>***This work is not limited to the subtasks described below, may be required by any of the RTD branches, and will be submitted through the NOC process.***<TD3

2.1 Subtask 1. (NOC) Dynamic Systems and Control

Carey S. Buttrill M/S: 308 Phone: 4-4016

The Contractor shall provide guidance and control design and analysis for Exploration, Science, and Aeronautics Projects in DSCB. The range of analyses may include Nichols charts, frequency response, gain and phase margin calculation, stability margins, performance margins, Monte Carlo analysis, gust response, power spectral densities, and failure probabilities. The generalized deliverables are described in Section 2.1.2 below.

2.1.1 Milestones (Optional): N/A, (Primarily surge activities on milestones associated with launch systems development and landing systems)

2.1.2 Deliverables and Schedule (Required): (NOC) Note: Specific deliverables and due dates will be clarified in the NOCs

a. Analysis models in electronic format, including model file, applicable results files, and any subsidiary files necessary to run the model.
b. Analysis reports documenting analysis work, model development, assumptions, requirements, cases run, results, issues and solutions.
c. Charts, tables, documents and electronic media documenting Contractor methods and results.
d. Source code (such as Fortran, C++ or Visual Basic) developed to automate running a model, analyzing results, or to support any DSCB task.
e. Charts, tables, documents, photographs, and other data required for documentation of the results of all thermal tests supported.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

For the above listed deliverables, Meets Requirements will be defined as delivery by due date (NOC); Exceeds Requirements will be defined as delivery one week or more prior to due date (NOC).

2.2 Subtask 2. (NOC) Flight Dynamics

Daniel G. Murri M/S: 308 Phone: 4-1160

Charles M. Fremaux M/S: 308 Phone: 4-1193

The Contractor shall provide flight control system design, flight data system analysis, parameter estimation analysis, simulation model implementation, and structural dynamics simulation. Tasks may include development and checkout of modified aerodynamic, flight controls, or structural models for use in simulation analysis; developing data analysis methods; and generating results from simulated flight tests including the effects of sensors. Additional duties may include analysis of flight performance, linear stability analysis, and nonlinear analysis including Monte Carlo approaches – all to support development of the vehicles and project milestones.

2.2.1 Milestones (Optional): N/A, (Primarily surge activities on milestones associated with launch systems, including launch abort, and landing systems development.)

2.2.2 Deliverables and Schedule (Required): (NOC) Note: Specific deliverables and due dates will be clarified in the NOCs

a. Reports, charts, tables, and any other data required for documentation of the work performed, methods used, and results. All products shall be provided in electronic format.
b. Flight control laws, simulation models, and analysis results in electronic format compatible with NASA tools. Tools include MATLAB®, Simulink®, LASRS++, or others as defined by the NOC.

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting") - for the above listed deliverables, Meets Requirements will be defined as delivery by due date (NOC); Exceeds Requirements will be defined as delivery one week or more prior to due date (NOC).

2.3 Subtask 3. (NOC) Structural Mechanics and Concepts

H. Kevin Rivers M/S: 190 Phone: 4-9393

A. The Contractor shall conduct thermal, structural and/or thermal-structural analyses and design studies of advanced structural 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 and material systems will be considered. Thermal and structural analyses are required to size and compare these 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.

B. 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.

C. The Contractor shall, as specified in individual NOC'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, design test fixtures, 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.

2.3.1 Milestones (Optional): N/A. (Primarily surge activities associated with launch systems, upper stages of launch vehicles, crew module, launch abort systems, landing systems, on planet surface systems, and Shuttle operations.)

2.3.2 Deliverables and Schedule (Required): (NOC) Note: Specific deliverables and due dates will be clarified in the NOCs

a. Finite element models and results suitable for presentation.
b. Short written reports of design studies, analyses and weight trades of various concept studies. Detailed weight statements for integrated airframe concepts, algorithms for estimating weights of non-modeled structural features, and written reports of analytical results.
c. Analyses, test plans, and instrumentation layouts in electronic and printed form.
d. Test specimens and hardware to the appropriate testing laboratory
e. Test support as clarified in the NOC.
f. Progress reports documenting the results in electronic form.

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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.

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:
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.

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.

All subtask elements are completed and all deliverables are met ahead of schedule

2.4 Subtask 4. (NOC) Durability, Damage Tolerance and Reliability

Jonathan B. Ransom M/S: 188E Phone: 4-2924
Edward H. Glaessgen M/S: 188E Phone: 4-8947

The Contractor shall perform the following general requirements as applicable to specific sub-elements A, B, and C described below:

- Conduct technology development of analytical, computational, and experimental methods to quantify behavior, durability, and damage tolerance and to validate performance of advanced materials and structures for aerospace applications in support of Langley programs.
- Conduct structural analyses and design studies, analysis of test specimens, and support for testing of advanced metallic and composite materials and structures representative of airframe, spacecraft, and space transportation systems in support of Langley programs.
- Conduct material characterization, fatigue and fracture testing of advance materials and structural systems in support of Langley programs.

A. Structural Analysis , Test and Design Support For Exploration and Aeronautics Projects: The objective of this sub-element is to perform structural analysis and design studies to verify methods and to assess and improve performance of NASA mission critical structures. The requirements are as follows:

a. Structural Analysis and Design Support

- 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, and stability analyses shall be performed. Linear and nonlinear deformations and stress levels shall be predicted. The Contractor may need to consider design modifications and perform analyses to evaluate the design improvements.
- The Contractor shall create local FEM models for investigating design concepts and damage tolerance.
- Drawings, boundary conditions, and loading conditions will be provided by NASA.
- Finite element models will be reviewed by NASA technical monitor and the Contractor shall incorporate the comments into the structural model.

b. (NOC) Structural Mechanics Test and Analysis Support

The Contractor shall provide analysis and test support for test analysis activities in structural mechanics and structural dynamics. Areas of support will include but are not limited to the following areas:

- Damage tolerance and durability analyses of metallic and composite aircraft and spacecraft structures and structural components
- Development of rapid analytic solutions for structural mechanics problems
- Structural response of metallic composite aircraft, spacecraft, or space transportation systems with and without stiffness discontinuities
- Evaluation of failure criteria for laminated composite structures
- Nonlinear structural analysis of built-up structural systems.
- Nonlinear dynamic analysis of metallic and composite aircraft and spacecraft.

2.4.1A Milestones (Optional): N/A. (Primarily surge activities associated with launch systems, upper stages of launch vehicles, crew module, launch abort systems, landing systems, on planet surface systems, and Shuttle operations.)

2.4.2A Deliverables and Schedule (Required): Note: Specific deliverables and due dates will be clarified in the NOCs

Deliverables:

- All the finite element models that have been created.
- The results (e.g., plots of deformed shape, stresses, and strains) of the finite element analyses.
- Monthly progress reports.
- A final report documenting the analysis results.

Schedule:

Drafts/revisions of contractor report due quarterly
All work is to be completed by December 31, 2008

2.4.3A Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS:

Complete structural analyses and document results for various design concepts delivered throughout contract performance and completed by December 31, 2008.

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

Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date (NOC); Exceeds Requirements will be defined as delivery one week or more prior to due date (NOC).

B. Characterization of Advanced Materials: As part of the Return to Flight, Exploration and the Advanced Vehicles program, LaRC has been tasked to evaluate the behavior of polymers, foams, polymeric composites, metallic materials 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. The subtask requirements are as follows:

a. The 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, foams, polymeric composites, metallic materials 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. The 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, plasticity and damage/fracture 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 DDTRB materials characterization laboratory. The Contractor shall report monthly on the progress of test apparatus development.

2.4.1B Milestones (Optional):

2.4.2B Deliverables and Schedule (Required): Note: Specific deliverables and due dates will be clarified in the NOCs.

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 December 31, 2008.

2.4.3B Performance Metrics/Standards (Required - Meets, Exceeds):

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

C. Fatigue and Fracture Testing of Aerospace Structures: Determine fatigue crack growth and residual strength behavior of aerospace materials and structural configurations. Conduct tests on laboratory coupons and integrally stiffened specimens. The subtask requirements are as follows:

- 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.

2.4.1C Milestones (Optional):

2.4.2C Deliverables and Schedule (Required): Note: Specific deliverables and due dates will be clarified in the NOCs

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
- 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 December 31, 2008.

2.4.3C Performance Metrics/Standards (Required - Meets, Exceeds):

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- test data reports
- all tests in subtask a 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
- Completion of additional tests not included in test matrix

2.5 Subtask 5. (NOC) Impact DynamicsAnalyses and Testing

Jill Marlowe	**M/S: 230**	**Phone: 4-7027**
Richard Boitnott	**M/S: 495**	**Phone: 4-4161**

A. Impact DynamicsAnalyses:

The Contractor shall perform analytical impact and landing simulations of spacecraft and aircraft using the nonlinear dynamic finite element code LS-DYNA. Subcomponents to be modeled include hybrid impact

dummies and energy absorbing features such as airbags or crushable structure. In addition, sub-tasks may also require analyzing experimental dynamic data (typically using Matlab or LabView software) and performing test and analysis correlations for model validation. Knowledge of the underlying physics of impact will be required to be able to build and understand the model output. This knowledge must include an understanding of dynamic impact behavior and strength of materials including material behavior in the linear, plastic, and failure regimes, for both metals and advanced composites. Analysis of digital data acquisition and manipulation including filtering shall be performed as part of the validation of computer models. Modeling of multi-terrain impacts such as impacts of aircraft and spacecraft onto hard surfaces, soft-soil, and water shall also be performed for these programs. Simulations may require the use of Lagrangian, Eulerian, or Smooth Particle Hydrodynamic (SPH) formulations within LS-DYNA. Simulations of ballistic impact such as turbine fan blade containment or impact of debris such as occurred during the Columbia accident may also be required.

2.5.1A (NOC) Deliverables and Schedule (Required): Note: Specific deliverables and due dates will be clarified in the NOCs

(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.
(3) Test/Analysis correlations.
(4) PATRAN or HyperWorks databases/session files, finite element models/input files of all models generated.
(5) Analysis files.
(6) Powerpoint files summarizing analysis results in format determined by the customer.

2.5.2A Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Work completed accurately and on time as agreed upon for each NOC.

Exceeds:

(1) Work completed ahead of schedule, or suggestions by Contractor to make model development and/or analysis easier, more accurate, or more efficient.
(2) Superior documentation of work.
(3) Fidelity and accuracy of Test/Analysis.

B. Impact Dynamics Testing:

The Contractor shall plan, perform, and/or provide consultation for experiments ranging from dynamic material characterization, subsystem or component impact testing, and full-scale impact tests of spacecraft and aircraft using government provided laboratories and equipment. Testing will include multi-terrain impacts such as impacts of aircraft and spacecraft onto hard surfaces, soft-soil, and water. Knowledge of the underlying physics of impact will be required to be able to design experiments and understand the results. This knowledge must include an understanding of dynamic impact behavior and strength of materials including material behavior in the linear, plastic, and failure regimes, for both metals and advanced composites. Full-scale testing will normally be conducted using the LandIR Facility including a 70ft Vertical Drop Tower, and test articles may include substantial integration of equipment such as Anthropomorphic Test Dummies, energy absorbing seats, and experimental energy absorbing subsystems such as airbags or crushable structures. Sub-system and component level tests will normally be performed at LandIR's 70ft Vertical Drop Tower or one of the interior drop towers. Dynamic material characterization using 3 point

bend tests and other standard methods will also be performed. The work includes specifying appropriate instrumentation for experiments, such as high-g accelerometers, motion tracking devices, and high speed, high definition video footage. Experimental data analysis will be performed for all types of instrumentation.

2.5.1B (NOC) Deliverables and Schedule (Required): Note: Specific deliverables and due dates will be clarified in the NOCs

(1) Weekly progress summaries and participation at weekly project meetings
(2) Test plans, test procedures and checklists for all tests.
(3) Reports summarizing results and conclusions for each test with digital charts, graphs, videos and photographs.
(4) Raw data files, post-processed data files, and documentation of data analysis techniques.
(5) Powerpoint files summarizing test results in format determined by the customer.

2.5.2B Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: Work completed accurately and on time as agreed upon for each NOC.
Exceeds:
(1) Work completed ahead of schedule, or suggestions by Contractor to make experimental activities easier, more accurate, or more efficient.
(2) Superior documentation of work.
(3) Fidelity and accuracy of experimental results.

2.6 Subtask 6. (NOC) Characterization and Processing of Advanced Materials
Stephen Hales M/S:188A Phone: 4-3128

A: Processing

The Contractor shall perform materials processing activities on a written NOC basis. The contractor shall ensure equipment is operational prior to and after the processing runs. 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 40 batches of specimens).
- Mechanical Processing: Sheet specimens shall be subjected to cold and warm rolling (up to 30 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 50 plasma spray runs).
- Consolidation: Thin foils of alloys and/or fiber-reinforced monotapes shall be laid up and consolidated using vacuum hot pressing to produce sheet and/or metal matrix composite laminates (up to 40 consolidation runs).
- Alloy Synthesis: Novel and advanced alloys shall be produced using casting (up to 30 runs) and ball milling (up to 30 runs).
- Refractory Composite Synthesis: Advanced refractory composite systems shall be synthesized and densified in configurations including, but not limited to, plates, thin sheets and disks, and

rods with features to accommodate various substrate contours and interface with high-temperature mechanical fastener systems (up to 40 batches).

Deliverables (for 2.6A):

- For each NOC, 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 NOCs completed during the reporting period, total cost associated with each NOC, the scheduling priorities for upcoming NOCs, 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.

Performance Standards (for 2.6A):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each NOC (electronic data in appropriate format for transfer to Excel spreadsheets)
- NOCs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:

- NOCs completed ahead of requested due date
- "rush" NOCs designated by the task monitor expedited
- Completion under cost

B Microstructural Analysis

The Contractor shall prepare specimens and perform routine and advanced laboratory analyses on a written NOC basis. The Government will provide the materials to be analyzed. 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 200).
- 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 30).
- 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 40).
- Conduct failure analyses on test coupons and structural components to determine the origin of and reasons for failure (up to 25).
- Conduct hardness and microhardness tests on metallic materials (up to 40).

Deliverables (for 2.6B):

- For each NOC, 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 NOC.
- For each NOC, 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 NOCs completed during the reporting period, costs, the scheduling priorities for upcoming NOCs, 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.

Performance Standards (for 2.6B):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in appropriate format for transfer to Excel spreadsheets)
- NOCs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- NOCs completed by requested due date
- Cost

EXCEEDS:

- NOCs completed ahead of requested due date
- "rush" NOCs designated by the task monitor expedited
- Completion under cost

C: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written NOC 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, polymeric composites, and refractory 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 250).
- 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 2.6C):

- For each NOC, 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 NOCs completed during the reporting period, costs, the scheduling priorities for upcoming NOCs, 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.

Performance Standards (for 2.6C):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in appropriate format for transfer to Excel spreadsheets)
- NOCs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:

- NOCs completed ahead of requested due date
- "rush" NOCs designated by the task monitor expedited
- Completed under cost

D: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written NOC 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. NOC tasks will include chemical or electrochemical cleaning, etching, milling and plating. The Government will supply the specimens (up to 250) 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 2.6D):

- For each NOC, 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 NOCs completed during the reporting period, the scheduling priorities for upcoming NOCs, 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.

Performance Standards (for 2.6D):

MEETS

- Quality of data generated for each test request (electronic data in appropriate format for transfer to Excel spreadsheets)
- NOCs completed by requested due date (accounting for complexity and competing requests).
- Quality of reports (meets NASA standards)
- Cost

EXCEEDS

- NOCs completed ahead of requested due date
- "rush" NOCs designated by the task monitor expedited
- Completion under cost.

E: 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 2.6E):

- 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.

Performance Standards (for 2.6E):

MEETS

- CMTS data meets NASA standards
- MSDS catalog remains up-to-date

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Subtask 1: The government will provide access to source and executable codes needed for the accomplishment of the assigned tasks. The Contractor shall be responsible to provide computer resources of enough capacity to accomplish the assigned tasks. Contractor computer resources shall be capable of running MATLAB® and Simulink®. DSCB will provide licenses and access to Matlab/Simulink®.

Computer models shall vary from very small to very large, including but not limited to computer models of full vehicle assemblies.

Subtask 2: The government will provide existing simulations, simulation models, or databases needed for the accomplishment of the assigned tasks, or to be used as a starting point for further development. The Contractor shall be responsible to provide appropriate computer resources and tools (such as MATLAB® and Simulink®) to accomplish the assigned tasks. Computer models shall vary from very small to very large, including but not limited to computer models of full vehicle assemblies.

Subtask 3: The Contractor will be provided access to UNIX workstations and associated CAD/CAE software, 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.

Test specimens
Test specimen instrumentation
Specialized measurement [R6] and 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 available)

Subtask 4: The government will provide access to source and executable codes needed for the accomplishment of the assigned tasks. The Contractor shall be responsible to provide computer resources of enough capacity to accomplish the assigned tasks. Contractor computer resources shall be capable of running DDTRB standard clients that include Collier Technology HypersizerPro; MSC NASTRAN, ABAQUS, PATRAN, and PATRAN Thermal; Intel C++ and Fortran compilers; MathLab; and Mathcad. Computer models shall vary from very small to very large, including but not limited to computer models of full vehicle assemblies.

Subtask 5:
Test specimens
Test specimen instrumentation
Laboratories for required testing
Access to NASA specialized structural analysis software, including MSC/NASTRAN, MSC/PATRAN and MSC/ADAMS, LS-DYNA, LS-Pre/Post, IDEAS, HyperWorks, LabView, Matlab, etc.
Computer CPU time for structural analyses
Office space

Subtask 6: 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.

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.

Metallurgical analysis equipment located in the Light Alloy Laboratory (Building 1205), including optical microscopes, SEMs, TEMs, x-ray diffraction systems, hardness and microhardness test machines, DTA and DSC systems, ICP system, and specimen preparation apparatus and supplies.

4. Other Essential Information:

- All Langley safety procedures shall be followed.
- 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.
- **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.

Any companies interested in bidding on Orion development activities are prohibited from performing work on this task.

Dissemination of significant results through periodic technical interchange meetings at other NASA centers and/or international forums, along with associated travel, may be required as appropriate.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

Secret clearances are not anticipated but all contract staff should be US citizens and have passed an NAC. LaRC ADP requirements apply. US Citizenship is required because contractor personnel will be exposed to ITAR information.

6. Period of Performance:

Planned start date: [TD1] January 02, 2008 Completion date: [R1] ~~December 31, 2008~~ [R2] ~~July 31, 2009~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): L. David Wall*

M/S: 162 Phone: 757-864- 2944

***Administrative TM for System approvals and general coordination. Specific subtask details, planning, and clarification should be coordinated with the POCs listed below.**

Other POC (Optional):

M/S: Phone:

Subtask POCs (Optional):

Subtask 1.	Carey S. Buttrill	M/S: 308	Phone: 4-4016
Subtask 2.	Daniel G. Murri	M/S: 308	Phone: 4-1160
	Charles M. Fremaux	M/S: 308	Phone: 4-1193
Subtask 3.	H. Kevin Rivers	M/S: 190	Phone: 4-9393
Subtask 4.	Jonathan B. Ransom	M/S: 188E	Phone: 4-2924
	Edward H. Glaessgen	M/S: 188E	Phone: 4-8947
Subtask 5.	Jill Marlowe	M/S: 230	Phone: 4-7027
	Richard Boitnott	M/S: 495	Phone: 4-4161
Subtask 6.	Stephen Hales	M/S:188A	Phone: 4-3128

TASK ORDER NUMBER: 066D3-NNL08AM06T Revision: 1 Change: 0 Date: October 9, 2008

Title: Exploration Computational Fluid Dynamics and Grid Generation Support for CASB

1. Purpose, Objective, or Background (Optional)

The Computational AeroSciences Branch (CASB) of the Research and Technology Directorate is responsible for performing computational research in aerodynamics and acoustics with applications in all speed regimes, from subsonic to hypersonic flight. The branch works to improve the fundamental understanding of physics associated with the fluid mechanics and noise generation for complex airframe systems. CASB is also responsible for performing Computational Fluid Dynamics (CFD) analyses of various classes of vehicles in support of NASA missions.

Technical Direction 1 (1/10/08): Updates the initial task order start date to January 9, 2008 as issued by the CO on 1/9/08 (see [TD1] below).

Revision 1 (10/9/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract Paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATION (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

The scope of this SOW is to provide CFD analysis and grid generation support for exploration projects in the Computational AeroSciences Branch (CASB) of the Research and Technology Directorate. CASB is responsible for the generation of aero database for the ARES class of configurations for the Crew Launch Vehicle and support of aeroelastic and vibroacoustic analysis of the flight vehicle. CFD tools employed for these analyses include FUN3D for flow analysis and TetrUSS unstructured grid generation tools, VGRID and GridTool . A combination of skilled Civil Servant and contractor workforce is used to complete these analyses, and this task addresses the requirements for skilled contractor personnel to perform the CFD analysis and grid generation-support tasks under the functional responsibility of the Computational AeroSciences Branch.

2.1. (NOC) Unstructured Grid Generation and CFD Analysis (Subtask 1):

2.1.1 The Contractor shall construct computational grids for accurately modeling aerodynamic flow around the complex ARES class of configurations. Grid requirements and specifications will be provided to the Contractor on a case-by-case basis. An expert knowledge of the TetrUSS unstructured grid generation tools, VGRID and GridTool, is required for this task as these tools shall be used in construction of the required grids.

2.1.2 Using the grids generated in 2.1.1 above, the Contractor shall set up the cases and run CFD code to acceptable level of convergence and post-process the results in graphical and report form. The test cases and flow conditions will be provided to the Contractor on a case-by-case basis. An expert knowledge of the FUN3D suite of software along with its pre- and post-processing capabilities is required as this unstructured CFD code shall be used to generate the required solutions for the configurations provided.

2.1.3 Deliverables and Schedule – Specific items and due dates to be clarified in each NOC.

a. Grid generated for the specified configurations in electronic format, applicable results files, and any subsidiary files necessary to run the CFD code using the generated grid.
b. CFD solutions generated using the grids in a., in electronic format as specified.

c. Analysis reports documenting the work, assumptions, requirements, cases run, results, issues and solutions.
d. Charts, tables, documents and electronic media documenting Contractor methods and results.
e. Source code (such as Fortran or C++) developed to automate running required cases, analyzing results, or to support any CASB task.
f. Miscellaneous charts, tables, documents, photographs, and other data required for documentation of the results.

2.1.4 Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date (NOC); Exceeds Requirements will be defined as delivery 3 days or more prior to due date (NOC).

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The government will provide access to CFD codes, grid generation software and high performance computer resources needed for the accomplishment of the assigned tasks. Specifically, access will be provided to the unstructured grid Navier-Stokes code FUN3D and TetrUSS unstructured grid generation tools, VGRID and GridTool. The Contractor shall be responsible to provide computer resources needed for CFD case setup, graphical display of data and report preparation.

4. Other Essential Information:

5. Security Clearance:

None Needed

6. Period of Performance:

Planned start date: TD1 1/9/2008 Completion date: R1 ~~12/31/2008~~ ***12/31/2009***

7. NASA Task Management:

Technical Monitor (Required): Joseph H. Morrison
M/S: 128 Phone: 4-2294

Other POC (Optional): Veer N. Vatsa
M/S: 128 Phone: 4-2236

TASK ORDER NUMBER: 016D2-NNL08AM07T Revision: 0 Change: 0 Date: November 29, 2007

Title: POST2 Software Enhancement, Support, Modification, and Maintenance

1. Purpose, Objective, or Background (Optional)

Vehicle design, development, testing, and operation include assessment of flight dynamics, performance and trajectory. The NASA Langley Research Center is an integral part of current and future robotic and human missions that involve atmospheric flight which require these vehicle analyses. The Program to Optimize Simulated Trajectories II (POST2) software is the tool used at NASA Langley to provide these analyses. POST2 is also transferred for government purposes to industry, academia, and government entities. The ability to adapt the POST2 software to changing technology and vehicle capabilities is required to keep POST2 able to support NASA missions and vehicle designs, development, and operations into the next decade. The current version is the result of many years of development and maintenance by Lockheed Martin Space Systems Corporation (Denver).

Technical Direction 1 (2/13/08): Updates the initial task order start date to February 12, 2008 as issued by the CO on 2/12/08 (see [TD1] below, Section 6).
Technical Direction 2 (09/19/08): Documents the extension of the period of performance 4 months to January 31, 2009 as authorized by the Contracting Officer in Mod 2, dated September 18, 2008 (see [TD2] below, Section 6).
Technical Direction 3 (12/22/08): Documents the extension of the period of performance 4.5 months to May 18, 2009 as authorized by the Contracting Officer in Mod 3, dated December 19, 2008 (see [TD3] below, Section 6).
Technical Direction 4 (5/12/08): Documents the extension of the period of performance 1 month to June 19, 2009 as authorized by the Contracting Officer in Mod 4, dated May 11, 2009 (see [TD4] below, Section 6).

2. Description of the Work to be Performed:

The Contractor shall update and adapt the existing NASA Langley Research Center version of the Program to Optimize Simulated Trajectories II (POST II) to do the following:

2.1 64-bit POST2:

The Contractor shall redesign and make code changes necessary for POST2 to operate natively on a 64-bit processor machine. All current capabilities of the POST2 software shall be retained while operating natively on a 64-bit computer. No input or output changes shall result from the change to the POST2 architecture or code to support operation on a 64-bit processor computer.

These upgrades and new subroutines shall be developed using C unless otherwise agreed between NASA's Technical Monitor and the Contractor's Task Leader.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

The Contractor shall on completion deliver fully functioning versions of the upgraded POST2 trajectory simulation code, which are free of all known programming errors, and sample case inputs/outputs which indicate the capabilities and acceptability of these tools. The Contractor shall provide a user's guide, model description document, and source code (except commercially available

packages used) for the developed tool(s). The Contractor shall provide brief, summary, written status reports of tool status. The Contractor shall provide detailed verbal and/or written reports (including demonstrations when necessary) of code status, integration, and architecture at monthly intervals. A detailed plan and schedule of code adjustments to support 64-bit architecture is due 30 days after ATP.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets – task is completed and code is delivered without defect while schedule is met and cost estimates are not exceeded.

Exceeds – completed task is delivered without defect ahead of schedule and cost estimates are not exceeded.

(See "System and Software Metrics for Performance-Based Contracting")

2.2 Integer Event Criterion:

The Contractor shall redesign and make code changes necessary for POST2 to use integer variables as criterion for initiating events. Any integer variable available in the POST2 dictionary shall be available as a criterion variable. None of the current multiple criteria capability (e.g., the event criteria Boolean logic) will be lost by including integer variables as event criterion.

These upgrades and new subroutines shall be developed using C unless otherwise agreed between NASA's Technical Monitor and the contractor's Task Leader.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

The Contractor shall on completion deliver fully functioning versions of the upgraded POST2 trajectory simulation code, which are free of all known programming errors, and sample case inputs/outputs which indicate the capabilities and acceptability of these tools. The Contractor shall provide a user's guide, model description document, and source code (except commercially available packages used) for the developed tool(s). The Contractor shall provide brief, summary, written status reports of tool status. The Contractor shall provide detailed verbal and/or written reports (including demonstrations when necessary) of code status, integration, and architecture at monthly intervals. A detailed plan and schedule of code adjustments to support integer use as criterion is due 30 days after ATP.

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets – task is completed and code is delivered without defect while schedule is met and cost estimates are not exceeded.

Exceeds – completed task is delivered without defect ahead of schedule and cost estimates are not exceeded.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Government will within five working days of ATP provide the Contractor with access to the current version of the NASA Langley Research Center POST2 software. The Government will also provide the Contractor with access to the AFESB (Atmospheric Flight & Entry Systems Branch) computers and the necessary software packages available in the AFESB (e.g., C compiler, etc.).

4. Other Essential Information:

Due to the urgent and compelling need to use the upgraded code, no time can be allotted for learning the POST2 code architecture.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

As the POST2 code is ITAR, appropriate securing of all source and documentation is required.

6. Period of Performance:

Planned start date: TD1 12 February 2008

Completion date: TD2 ~~30 September 2008~~
TD3 ~~January 31, 2009~~
TD4 ~~May 18, 2009~~
June 19, 2009

7. NASA Task Management:

Technical Monitor (Required): **Scott Striepe**
M/S: 489 Phone: 864-4512

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 003C2-NNL08AM08T Revision: 1 Change: 0 Date: April 22, 2008

Title: Langley Management System Internal Audit Services (Surge Capability)

1. Purpose, Objective, or Background (Optional)

NASA Langley Research Center (LaRC) is a world class Aerospace Government laboratory that has as its Mission to Pioneer the Future in Space Exploration, Scientific Discovery, and Aeronautics through Research and Development of Technology, Scientific Instruments, and Exploration Systems. The Center employs approximately 2000 Civil Service Employees as well as various contractors that support its operations.

LaRC intends to retain ISO 9001:2000 (ISO 9001) certification for a scope which includes all of the center's activities. LaRC simultaneously intends to seek an additional certification for AS9100 RevB (AS9100) which focuses on the additional requirements in AS9100B over-and-above the ISO 9001 requirements for a specified subset of center activities.

The purpose of this Statement of Work (SOW) is too provide LaRC with short-term surge-support needed to complete Internal Audit (IA) activities and associated documentation for ISO 9001 and AS9100 in preparation for a 6-month ISO 9001 Surveillance Audit and an AS9100 Registration audit within a 4-month period of time (January through April, 2008). The ISO 9001 surveillance and AS9100 Registration 3rd party audits are currently planned to occur in May 2008.

The scope of the ISO 9001 registration of the Langley Management System (LMS) covers all Civil Service operations; the Quality Management System requirements of outsourced activities are controlled through the end-to-end procurement process.

ISO 9001 Registration Certificate Scope Statement

All civil service activities associated with design, analysis, development, and delivery of aerospace vehicle systems technologies and scientific research of all planetary atmospheres.

In addition, the Center is actively pursuing AS9100 certification for a subset of the management system where additional rigor is desired and appropriate.

AS9100 Scope applicability

Processes and services that support the design, development, fabrication, component assembly, and system installation of flight hardware, flight software, and associated ground support equipment interfacing with flight hardware and flight software.

Auditor Qualifications:

Auditors must have the training and experience reflected by Lead Auditor Certification issued by an International Accreditation Foundation (IAF) recognized United States (National) ISO 9001/AS9100 Registration Body or its equivalent. Skills and experience with auditing of government organizations will be considered desirable. Evidence documenting the appropriate Company and Auditor qualifications must be provided to LaRC prior to the start of the stated period of performance.

Technical Direction 1 (1/10/08): Updates the initial task order start date to January 14, 2008 as issued by the CO (see TD1 below, Section 6).
Revision 1 (4/22/08): Extends the period of performance 2 months in continuation of NASA's support with

expanded requirements as new Subtask 4 (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Technical Subtask Requirements:

Subtask 1

In accordance with surge capability deliverables, the Contractor shall provide internal audit planning, assessment and reporting services with regard to compliance of all Civil Service Operations to established internal controls as well as applicable external requirements. In addition, the Contractor shall provide appropriate review of the overall LMS infrastructure to ensure ongoing compliance required to maintain ongoing ISO 9001 registration. Internal Audits shall be conducted according to the Center Procedure, LMS-CP-2305.

Typically, Internal Assessment schedules are designed to ensure complete system assessment over an 18-month period. However for this surge effort additional audits must be performed in an abbreviated timeframe. (See deliverables below). These individual audit plans and checklists will be approved by the government prior to implementation. The Contractor shall also be responsible for submitting requests for corrective action via LaRC's Corrective, Preventive and Improvement Action Tracking System (CAP Tracs) web-based tool, monitoring timely response to audit findings, and reporting any issues to the acting Internal Assessment Program Manager or the LMS Management Representative.

Subtask 2

The Contractor shall provide internal audit planning, assessment and reporting with regard to compliance of all Civil Service Operations performed within the scope of AS9001 requirements (as previously noted) to established internal controls as well as applicable external requirements. In addition, the Contractor shall provide appropriate review of the applicable components of the LMS infrastructure to ensure ongoing compliance required to maintain ongoing AS9001 registration. Internal Audits shall be conducted according to the Center Procedure, LMS-CP-2305.

The Contractor Lead Internal Auditor(s) shall integrate AS9100 compliance assessments into the overall planning and conducting of LMS internal audits (see subtask 1).

Subtask 3

Multiple Contractor auditors are anticipated to meet this surge internal assessment schedule; however dependent upon the progress in meeting audit requirements, the government may require one contracted internal auditor to serve as an interim consultant on best practices and compliance recommendations to the LaRC AS9100 Transition Team.

*****Begin [R1] block expansion*****

Subtask 4

The Contractor shall perform an independent and comprehensive review of LaRC's metrology system with regard to its compliance to the AS9100 quality standards. The Contractor shall provide one or more auditors

(as needed) with AS9100 certification(s) and verifiable expertise in the fields of metrology and calibration, and with broad knowledge of industry standard practices in these areas. The auditor(s) shall perform the metrology system reviews at LaRC and create written documentation and reports with regard to compliance to AS9100 requirements. Methods consisting of document reviews, visits to labs and facilities, observations and hands-on inspections and personnel interviews shall all be used as tools to sample LaRC equipment, tools and instrument calibration efforts, including corrective actions, preventive actions and related record keeping across the center. The Contractor auditor(s) shall also provide interested LaRC personnel with individual consultation services with respect to metrology issues during the performance period, and additionally provide advice on industry standard metrology practices (only appropriately releasable information). Formal, written reports recording the auditor(s) observations as to evaluations of compliance of LaRC practices to the AS9100 standard, as well recommendations on methods and means to achieve compliance shall be provided within the agreed to performance period.

2.1.1 Milestones (Optional): Milestones for Subtask 4 include:

a) Metrology review plan developed with Civil Servant inputs, 1-3 days after issue of Revision 1.
b) Metrology system document reviews, 4-6 days after issue of Revision 1.
c) Visits to labs and facilities, inspections, interviews, and draft reports, 6-30 days after issue of Revision 1.
d) Consultations, follow-up visits (if needed), and final reporting activities, 30-45 days after issue of Revision 1.

*****End [R1] block expansion*****

2.1.2 Deliverables and Schedule (Required):

1) The Contractor(s) shall provide inputs to the Government developed Internal Assessment schedule to ensure:

   - All processes/work areas subject to the scope of LaRC's defined AS9100 registration are assessed for compliance to both ISO 9001 and AS9100 delta requirements
   - All processes scheduled, but not completed from the FY 2007 Internal Assessment schedule are reviewed for compliance to ISO 9001 requirements or AS9100 as appropriate.

   Ongoing: These inputs are to support the Government in being able to meet such requirements by April 4, 2008.

2) The Contractor shall provide to LaRC a non-proprietary AS9100 Checklist which will be used by the Auditors while performing internal audits at LaRC. This AS9100 Checklist must be transferable to LaRC as a deliverable product with no caveats, along with any rights to use the Checklist by LaRC or LaRC-contractor personnel during future internal audits. Although the Company may use additional Company-proprietary tools while performing IA audits at LaRC, the Company Auditors must document in writing all their observations, interview quotations, objective evidence, opinions, etc. in writing on the non-proprietary AS9100 Checklist pages and provide these Working Papers as part of the official files for each audit conducted. All such documentation should be in compliance with established Center procedures for planning, conduct and reporting of internal assessments. Ongoing.

3) Internal audit assessments completed according to established plan. Weekly

4) For each day audit activities are performed, the Contractor shall provide ½ hour debriefs at the end of the working day to an audience of AS 9100 Transition Team Lead (also serving as Internal Assessment Program Manager, acting) and any other appropriate LaRC personnel.

5) Written reports on each individual assessment in accordance with established Center Procedures. Ongoing

6) End-of-the-month interim written reports of all findings identified during the month. This report should also report on progress in addressing previously identified non-conformances.

7) End-of-the-month briefings to LaRC AS9100 Transition Team and other appropriate LaRC personnel summarizing the month's activities and findings

8) A final report summarizing all the Company's major activities, findings identified, severity of findings, and appropriately mapped to AS9100/ISO 9001 clauses, including objective evidence, LaRC personnel interviewed, etc. April 30, 2008.

9) R1> ***Subtask 4: Estimated level of effort is 15-20 person-days, provided within 45 days after issue of Revision 1. Draft reports are due 6-30 days after issue of Revision 1. Consultations, follow-up visits (if needed), and final reporting activities are due 30-45 days after issue of Revision 1.*** <R1

All reports, Interim and Final, should be provided in hardcopy and electronic copy using Microsoft applications consistent with Center protocols or forms defined within established Center procedures.

All Working Papers as part of interim and final reports using both hardcopy (Adobe PDF) and retyped into electronic format using Microsoft Office applications approved by the government to insure legibility of the Checklist data.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: Timely, thorough, and clearly written deliverables.

Exceeds: MEETS plus completion of all requirements by ~~March 28, 2008~~.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: LaRC will provide a preliminary Internal Assessment schedule at the start of this effort. Furthermore, LaRC will provide the Contractor Lead Internal Auditors with escorts

during all audit field visits. LaRC personnel will also provide any needed support to identify appropriate interviewees at the center during development of individual audit plans, as well as to help identify new LaRC contacts if real-time changes to such plans are required for any reason, such as personnel absence due to sickness, annual leave, business travel, or pursuit of real-time audit "threads", etc. LaRC personnel will also provide copies of LaRC procedures to the Company auditors if needed outside the interview process.

4. Other Essential Information:

All official records resulting from the work defined in this SOW will be considered the property and responsibility of the Government.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: TD1 January 14, 2008 Completion date: R1 ~~April 30, 2008~~ ***June 30, 2008***

7. NASA Task Management:

Technical Monitor (Required): John B. Malone

M/S: 304 Phone: 864-8988

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 067D3-NNL08AM09T Revision: 2 Change: 0 Date: February 23, 2009

Title: Supersonic Aeroelastic Analysis, Wind-Tunnel Test, and Data Processing Support

1. Purpose, Objective, or Background (Optional)

The goal of this task order is to provide support for the Supersonics APSE (Aero-Propulso-Servo-Elasticity) program in the form of linear and nonlinear (CFD-based) aeroelastic analyses, wind-tunnel test support, and data processing and analysis.

Technical Direction 1 (2/12/08): Updates the initial task order start date to February 11, 2008 as issued by the CO on 2/9/08 (see [TD1]below, Section 6)
Revision 1 (5/13/08): Updates requirements to reflect updated test/analysis schedule (see [R1] below).
Revision 2 (2/23/09): Updates requirements to reflect updated test/analysis schedule and extends the period of performance 12 months to April 30, 2010 (see [R2] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

– The Contractor shall perform CFD-based steady, static aeroelastic, and dynamic aeroelastic analyses of the S4T (SuperSonic SemiSpan Transport) wind-tunnel model using the CFL3D code. [R1>]Results, including a discussion of issues/problems and lessons learned shall be documented in a contractor-specified report format.[<R1]

Begin [R1] block update

2.1.1 Milestones (Optional):

- [R2>]~~Steady CFL3D results for the S4T model – July 15, 2008~~[<R2]
- Unsteady CFL3D results for the S4T model – [R2]***June 15, 2009***
- Static aeroelastic CFL3D results for the S4T model – [R2]***September*** 15, 2009
- Dynamic aeroelastic CFL3D results for the S4T model – [R2]***October*** 15, 2009
- CFD-based [R2>]***Aeroservoelastic (ASE) math models***[<R2] at six Mach numbers and four dynamic pressures ([R2>]***sometime after October ? 2009***[<R2])

2.1.2 Deliverables and Schedule (Required):

Interim Report - 30 [R2]***April 2009***
[R2>]***Interim Report - 30 October 2009*** [<R2]
Final Report - 30 April [R2]***2010***

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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).

End [R1] block addition

2.2 (Requirement/subtask number two):

- The Contractor shall participate in the closed-loop test of the S4T scheduled to start in [R2]***May*** 2009 and scheduled to last four weeks
- The Contractor shall support pre-test activities involving S4T model preparations, calibrations, and analyses for the closed-loop test
- The Contractor shall support post-test activities involving S4T model data post-processing, analysis, and reporting for the closed-loop test

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

- Data analysis of [R1>]closed-loop test of S4T wind-tunnel model ([R2]***July*** 2009)[<R1]

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: Timely and complete test and analytical support.

Exceeds: Suggestions that enable successful test and/or identification of analytical/data anomalies/procedures that provide more enhanced analysis.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: Access to CFL3D code.

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: [TD1] February 11, 2008 Completion date: [R2] ~~April 30, 2009~~ ***April 30, 2010***

7. NASA Task Management:

Technical Monitor (Required): Walter A. Silva
M/S: 340 Phone: 757-864-2834
Other POC (Optional): Boyd Perry, III
M/S: 340 Phone: 757-864-2840

TASK ORDER NUMBER: 017D2-NNL08AM10T Revision: 0 Change: 0 Date: January 9, 2008

Title: MSL Heat Shield Material Pressure Port Performance Evaluation

1. Purpose, Objective, or Background (Optional)

Background

The Mars Science Laboratory (MSL), scheduled for launch in 2009, will incorporate pressure measurement instrumentation in the heat shield to measure the surface pressure response during the Entry, Descent, and Landing (EDL) phase in the Martian atmosphere. The MSL Entry, Descent, and Landing Instrumentation (MEDLI) / Mars Entry Atmosphere Data System (MEADS) program will incorporate pressure ports through the external heat shield connected to pressure transducers internal to the spacecraft to measure the pressure response on the surface of the heat shield.

In October 2007, the Thermal Protection System (TPS) heat shield for MSL was changed from Super Lightweight Ablator (SLA) -561V material to Phenolic Impregnated Carbon Ablator (PICA) material. The MEDLI/MEADS program will demonstrate acceptable pressure port operation in the PICA material with a series of arc-jet runs similar to an earlier set of arc-jet tests (performed in this same facility) evaluating the performance of pressure ports in SLA-561V material.

Arc jet tests at a facility such as the Boeing Large Core Arc Tunnel (LCAT) will evaluate various size pressure ports (0.070 and 0.100-inch diameter) in the PICA heat shield material at relevant entry heating rates. The LCAT facility has been used for MEDLI development tests twice before in the past 18 months, and is one of only 3 facilities in the country that can meet these test conditions. The other 2 facilities are at NASA-Ames and NASA-JSC. Both of those facilities are fully subscribed and cannot support the MEDLI development schedule. A Sole Source Synopsis was issued in March 2007 for similar testing, and no other suppliers were identified. Since then, no other facilities of this caliber have been brought into production, making LCAT still the ideal place to perform this work.

Test Objectives

The overall test objective is to evaluate pressure port performance in the new MSL heat shield material, PICA, under simulated MSL entry aeroheating conditions. This evaluation includes two pressure port sizes, 0.070-inch and 0.100-inch, at various heating rates which simulate various locations on the MSL heat shield. In addition the pressure ports will have either a 0.750-inch long stainless-steel sleeve or a 0.100-inch long sleeve. The sleeve may be important to reduce pyrolysis effects on the pressure measurement. This test series will evaluate whether this phenomena is a concern. The desired outcome from this test is to down select to either a 0.070-inch or 0.100-inch diameter pressure port and determine if a sleeve is required.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall test stagnation arcjet models, provided by NASA-LaRC. The test matrix of conditions and model configurations are given in Attachment A. The Contractor shall select the appropriate nozzle size and facility configuration to match these stagnation conditions as closely as possible. The Contractor shall obtain the Langley Arc Jet Test Lead's concurrence on the acceptable test conditions for each run, based on calibrations.

The heat flux and stagnation pressure shall be held at a constant value for the duration of the run unless the Langley Arc Jet Test Lead specifies that the model be removed from the flow earlier. The Contractor test director may also terminate the test or remove the model from the flow for facility safety concerns.

A calibration run shall be performed prior to each run measuring the Pitot pressure and stagnation heat flux to verify appropriate test conditions. The Contractor shall use the Boeing fabricated 3.5-inch diameter slug calorimeter and the 3.0-inch Ames calorimeter on each calibration run to determine the flow-field conditions. In addition, a 3.5-inch Teflon calibration model, provided by Langley, shall be tested on each calibration run. If the conditions are within a predetermined tolerance band (tolerance to be determined by the Langley Arc Jet Test Lead) the test models shall be installed and the test run shall be performed. If the test conditions are not acceptable, the Contractor shall attempt to adjust the conditions to meet the test requirements prior to proceeding to the test run.

The Langley Arc Jet Test Lead may request a test matrix change or model change with the understanding that it may impact schedule. The LCAT Test Engineer will be notified 24-hours in advance of any potential changes if possible.

The Contractor shall supply the heat flux/stagnation pressure probes. In addition, The Contractor shall provide a sting arm adapter module to allow pressure tube changes.

Specimen Pre-Test Preparation

1. Each specimen shall be inspected on receipt for any shipping damage. Any damage shall be reported to the Langley Arc Jet Test Lead and documented.

2. Pre-test photographs shall be taken of each specimen to thoroughly document the pre-test condition.

3. Pre-test weights of the samples shall be made and recorded.

4. Each test specimen shall be kept in a controlled storage area until tested. Positive identification of each test specimen shall be maintained at all times.

Specimen Post-Test Disposition

1. The Contractor shall examine the specimen on the sting in the specimen holder after exposure and cool-down.

2. Post-test photographs shall be taken of each specimen inside the chamber if data will be lost from movement of the model. Additionally, photos shall be taken of the model after removal from the test facility.

3. Post-test weights of the samples shall be made and recorded.

4. Post-test recession measurements shall be made at nine different locations on the model surface as

determined by the Langley Arc Jet Test Lead.

5. Upon completion of testing and post-test documentation, selected samples as determined by the Langley arc jet test lead shall be appropriately packaged, labeled, and express shipped to NASA-Langley for further examination.

Langley Shipping Address:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

Test Data

1. Temperature plots for each test sample shall be generated and provided to the Langley Arc Jet Test Lead with the final data package or sooner at the discretion of the Contractor.

2. Facility operating conditions including enthalpy, pressure, mass flow rate, arc current, arc voltage, etc, shall also be provided to the Langley Arc Jet Test Lead with the final data package or sooner at the discretion of the Contractor.

3. Test data shall also be provided electronically to designated recipients (see section 6.0 Test Documentation and Reporting).

Photographic Coverage

The Contractor shall take close-up digital photographs (in addition to overall views discussed above) of any damage or change as the post-test condition of any specimen warrants. Each photograph shall be identified using photo cards and contain the following minimum information:

1. Test Title
2. Test Date
3. Test Number
4. Part Identification Number
5. Pretest/Test/Post-test Chronology
6. Description of View (front, back, side, etc.)

The Contractor shall provide one set of preliminary photographs to the Langley Test Lead upon request. Photographs providing required information shall be included in the Test Report. One set of the archived photographs shall be provided to the Langley Test Lead in the final data delivery.

Video Coverage

The Contractor shall video record the model face and side views during the tests to verify model performance. Copies of the test video shall be delivered to the Langley Arc Jet Test Lead in the final

data delivery.

2.1.1 Milestones (Optional): No specific milestones pertain to this work. The test matrix is expected to be completed within 2 weeks (10 business days).

2.1.2 Deliverables and Schedule (Required):

Test Documentation and Reporting

Data may be e-mailed or shipped by mail. In addition, the Contractor shall deliver video and photos (pre and post-test) by e-mail or mail as soon as practical (the same day) following each test to the designated people below:

Name	e-mail address
Walt Bruce	Walter.E.Bruce@ nasa.gov
Kaitlin Liles	Kaitlin.A.K.Liles@nasa.gov

Following completion of the test program, the Contractor shall deliver all data and documentation to the Langley Arc Jet Test Lead (including copies of any reports written). The following documentation shall be prepared in a report containing:

1. Pre and post-test weights of each test sample
2. Pre and post-test photographs of each test sample
3. Plots from test runs of temperature and pressure
4. Facility operating conditions (enthalpy, pressure, arc current, arc voltage, mass flow rate, etc.) at a minimum for each test condition. The preferred format is a tabulated set of data in digital format, for each parameter versus time.

The Contractor shall deliver all test data to the Langley Arc Jet Test Lead as soon as possible, but not later than two weeks after the conclusion of the test. All test models shall be shipped to the Langley Arc Jet Test Lead no later than one week after the conclusion of the test.

Return Shipping Addresses

Ship post-test samples, complete report package and all data to:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Twelve (12) test runs, per provided test matrix, successfully completed (conditions met to NASA satisfaction, no facility anomalies)

Exceeds: Greater than 12 test runs successfully performed within the test window (conditions met to NASA satisfaction, no facility anomalies)

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: All test samples and test specimen holders will be provided by NASA-Langley. All of the test articles will be preassembled and shipped to Boeing-St. Louis at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test. Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request. A 3.5-inch Teflon calibration sample will also be provided by NASA-LaRC.

4. Other Essential Information:

Contractor personnel shall participate in a Test Readiness Review (TRR) via telecon within 7 business days before the scheduled test start. Telecon arrangements will be made by the Langley Arc Jet Test Lead, in coordination with the Contractor personnel.

Test Notification and Attendance

The Contractor shall provide the Langley Arc Jet Test Lead sufficient notice in advance of a test to permit attendance at the test. The Langley Arc Jet Test Lead shall be notified of any changes to the test schedule.

The Contractor shall accommodate a representative from Lockheed Martin Space Systems Company to witness the testing in its entirety.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): No security clearances or other special provisions are required, other than the sample handling requirements specified above.

6. Period of Performance:

Planned start date: February 15, 2008 Completion date: March 31, 2008

7. NASA Task Management:

Technical Monitor (Required): Walter Bruce
M/S: 431 Phone: 757-864-7024

Other POC (Optional): Michelle Munk
M/S: 494 Phone: 757-864-2314

Attachment A: Test Matrix

MEADS PICA Development Test - Stagnation
Facility: Boeing LCAT Nozzle De = 4.0"

Stagnation Test, Model Dia = 3.5"

Test Condition Rationale:

Demonstrate pressure port integrity and pressurement measurement at revelant conditions for each port location
Match pressure, heat rate, and heat load corresponding to pressure port location

Test Condition	NASA Run Number	Target Test Conditions: Hot wall Heat Flux (W/cm^2)	Cold Wall Heat Flux (W/cm^2)	Stagnation Pressure (atm)	Test Duration (sec)	Total Energy Load (J/cm^2)	Test Models, Sting Arm Position: 1	3	4	5	Comment
1	Cal-1	130		0.20	36	4680	A	X	B	C	P5 - Highest Heating Rate (+3 sigma)
1	1	130		0.20	36	4680	A	E-NC	D-NC	E-C	P5 - Highest Heating Rate (+3 sigma)
1	2	130		0.20	36	4680	A	E-C	D-C	E-NC	P5 - Highest Heating Rate (+3 sigma)
1	3	130		0.20	36	4680	A	F-NC	D-NC	F-C	P5 - Highest Heating - Fiber Orientation
1	4	130		0.20	36	4680	A	F-C	D-C	F-NC	P5 - Highest Heating - Fiber Orientation
2	Cal-2	120		0.26	40	4800	A	X	B	C	P4 - Highest Heat Load (+3 sigma)
2	5	120		0.26	40	4800	A	E-NC	D-NC	E-C	P4 - Highest Heat Load (+3 sigma)
2	6	120		0.26	40	4800	A	E-C	D-C	E-NC	P4 - Highest Fiber Orientation
3	Cal-3	95		0.30	43	4085	A	X	B	C	P3 (+3 sigma)
3	7	95		0.30	43	4085	A	E-NC	D-NC	E-C	P3 (+3 sigma)
3	8	95		0.30	43	4085	A	E-C	D-C	E-NC	P3 (+3 sigma)
4	Cal-4	55		0.30	42	2310	A	X	B	C	P1 & P2 (+3 sigma)
4	9	55		0.30	42	2310	A	E-NC	D-NC	E-C	P1 & P2 (+3 sigma)
4	10	55		0.30	42	2310	A	E-C	D-C	E-NC	P1 & P2 (+3 sigma)
5	Cal-5	TBD		0.30	TBD	TBD	A	X	B	C	Contingency High Heating
5	11	TBD		0.30	TBD	TBD	A	E-NC	D-NC	E-C	Contingency High Heating
5	12	TBD		0.30	TBD	TBD	A	E-C	D-C	E-NC	Contingency High Heating

Model Name	Stagnation Model Description: Type	Pressure Ports	Coated	Fiber Orient.
A	3.5" Ames Slug	NA	NA	NA
B	3.5" Boeing Slug	NA	NA	NA
C	3.5" Teflon	No Port	NA	NA
D-NC	3.5" PICA	No Port	No	Parallel
D-C	3.5" PICA	No Port	Yes	Parallel
E-NC	3.5" PICA	4-Ports	No	Parallel
E-C	3.5" PICA	4-Ports	Yes	Parallel
F-NC	3.5" PICA	4-Ports	No	??-deg*
F-C	3.5" PICA	4-Ports	Yes	??-deg*
X	No Test Model			

*Maximum fiber orientation angle on nose cap, P4 location

TASK ORDER NUMBER: 001A5-NNL08AM11T Revision: 1 Change: 0 Date: January 29, 2009

Title: ESSP Program Configuration & Data Management (C&DM) Support

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to provide Configuration and Data Management (C&DM) Support to the Earth System Science Pathfinder (ESSP) Program.

Technical Direction 1 (2/26/08): Updates the initial task order start date to February 26, 2008 as issued by the CO on 2/26/08 (see [TD1] below, Section 6).
Technical Direction 2 (10/28/08): Adds clarification to 2.2.2 Information Management (see [TD2] below).
Revision 1 (1/29/09): Extends the period of performance 12 months to February 15, 2010 in continuation of NASA's support requirements, updates the requirements with some additions and renumbered subtasks, and notes the completion status of previous subtask 2.1 (see [R1] below).

2. Description of the Work to be Performed:

2.1 Development Tasks ([R1]*Completed*)

2.1 ([R1]*Previous 2.2.1, and so on below)* Configuration & Document Management

ESSP Program Configuration & Document Management (C&DM) support shall be performed as follows:

a. [R1>]***Implement the ESSP Program C&DM Plan and archival system***[<R1]
b. *Evaluate* recommended items to be configuration controlled and *report* findings to the ESSP Program Office for approval to be included in the configuration management program.
c. Facilitate the use and implementation of the ESSP Program Office configuration management processes and CM Plan.
d. Coordinate network user accounts and user access control of the Configuration Management system.
e. *Develop* and *maintain* database entries for reporting configuration management activities to the ESSP Program Office management.
f. Serve as Secretary on the ESSP Program Office Control Board.
g. *Perform* Configuration Management audits and *assist* in quality assurance and physical audits.
h. Serve as the ESSP Program Office Release Desk

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

i. Develop and maintain documentation security process for ESSP Program Office.
j. Comply with NASA Configuration, Document and Records Management policies and procedures to include NPD 1440.6X, NPR 1441.1X, and NASA Standard 0005.

*****End [R1] block addition*****

2.2 Information Management

Configuration management for ESSP requires collecting and sharing of information from Program Office staff, projects within program, and stakeholders within the program and outside the program. [TD2>]This information management includes coordination, facilitation, and maintenance of web site, graphics, and various other ESSP Program Office data.[<TD2] Once this information is collected, data and knowledge shall be conveyed to ESSP Program Office to ensure proper review and configuration management through performance of the following requirements:

1. Maintenance of ESSP Program archive [TD2]and web site.

2. TD2 Coordination of ESSP Office data
3. Coordination of network user accounts and control of user access to the IM system.

2.3 Library Management

To ensure Configuration Management, an ESSP Program documentation library is required. The library will be the central location where documentation is stored. It includes deliverable documentation from ESSP Projects as well as correspondence and reports. Management of the ESSP Program library shall be performed as follows:

a. *Maintain* the master library for all baselined documents and *assist* in the classification and filing of documentation.
b. Review all documentation for compliance with ESSP Program processes.
c. Coordinate all ESSP Program document releases, changes, waiver requests, and deviations.
d. Control electronic and hardcopy access to library materials with emphasis on proprietary restrictions.
e. Maintain ESSP Program data archive.

2.4 Action Item/Receivable Deliverable Management

To ensure effective ESSP Program Configuration Management, Action Item (AI) documentation shall be tracked and available to the ESSP Program staff through performance of the following requirements:

a. Continued implementation of AI tracking for reviews and technical interface meetings to include ESSP Program Reviews, Technical Meeting, Business Meeting, Project Baseline Reviews, Projects Monthly and Quarterly Reviews.
b. Maintenance of AI system processes and database.
c. Maintenance of receivable/deliverable system processes and database.

2.5 C&DM Agency Responsibilities

The continuing tasks provide maintenance of C&DM policies, process, and procedures developed as part of the development task. The Contractor shall perform continuing task actions as follows:

1. Coordinate ESSP electronic document activities/issues with contacts within ESSP Program's projects and LaRC/Agency IT community.
2. Act as ESSP Program POC for C&DM issues/activities.
3. Provide program management with *expert advice and recommendation* regarding agency and center C&DM policies and procedures.
4. Provide expert C&DM advice and guidance to ESSP Program staff.
5. Keep program management and cognizant project personnel informed of pending changes in C&DM requirements at agency and center level.
6. Coordinate C&DM and document management related issues amongst ESSP Program projects personnel for policy/procedure issues and IT security and firewall issues.
7. Maintain the ESSP Program C&DM plan and library.
8. Archive and retain ESSP Program records.
9. Develop and maintain C&DM templates (documents, presentations, forms, etc.).

2.6 Continuing Tasks Deliverables

Deliverables	Due Date
1. C&DM Control List Report with status	Monthly
2. Library Control List Report with status	Monthly
3. Action Item and Receivable/Deliverable Status Report	Weekly
4. Special C&DM reports and presentations to communicate ESSP's C&DM policies, procedures and statuses	Variable
5. Additional reporting requirements cited in C&DM Plan	Variable

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

Standard 1: Develop and deliver C&DM Control List Report with updated status to ESSP Program.

CUSTOMER SERVICE/RATING:

Excellent: The ESSP Program C&DM Control List Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ESSP Program Manager upon delivery to review the report.

Very Good: The C&DM Control List Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ESSP Program Manager in a timely manner.

Satisfactory: The C&DM Control List Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ESSP Program Manager.

Poor: The C&DM Control List Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ESSP Program Manager.

Unsatisfactory: No C&DM Control List Report is delivered to the customer, and the ESSP Program Manager has not given a waiver.

Standard 2: Develop and deliver Library Control List Report with updated status to ESSP Program.

CUSTOMER SERVICE/RATING:

Excellent: The ESSP Program Library Control List Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ESSP Program Manager upon delivery to review the report.

Very Good: The Library Control List Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ESSP Program Manager in a timely manner.

Satisfactory: The Library Control List Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ESSP Program Manager.

Poor: The Library Control List Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ESSP Program Manager.

Unsatisfactory: No Library Control List Report is delivered to the customer, and the ESSP Program Manager has not given a waiver.

Standard 3: Develop and deliver Action Item and Receivable/Deliverable (AIRD) Status Report with updated status to ESSP Program.

CUSTOMER SERVICE/RATING:

Excellent: The ESSP Program AIRD Report is delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ESSP Program Manager upon delivery to review the report.

Very Good: The AIRD Report is delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ESSP Program Manager in a timely manner.

Satisfactory: The AIRD Report is delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ESSP Program Manager.

Poor: The AIRD Report does not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ESSP Program Manager.

Unsatisfactory: No AIRD Report is delivered to the customer, and the ESSP Program Manager has not given a waiver.

Standard 4: Develop and deliver Special Reports and Presentations to ESSP Program.

CUSTOMER SERVICE/RATING:

Excellent: The ESSP Special Reports and Presentations are delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ESSP Program Manager upon delivery to review the report.

Very Good: The ESSP Special Reports and Presentations are delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ESSP Program Manager in a timely manner.

Satisfactory: The ESSP Special Reports and Presentations are delivered to the customer on the specified due

date with minimum errors. Contractor reviews Progress Report with ESSP Program Manager.

Poor: The ESSP Special Reports and Presentations do not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ESSP Program Manager.

Unsatisfactory: No ESSP Special Reports and Presentations are delivered to the customer, and the ESSP Program Manager has not given a waiver.

Standard 5: Develop and deliver additional reports per the C&DM Plan to the ESSP Program.

CUSTOMER SERVICE/RATING:

Excellent: The ESSP additional reports per the C&DM Plan are delivered to the customer on the specified due date with no errors. Contractor schedules a meeting with ESSP Program Manager upon delivery to review the report.

Very Good: The ESSP additional reports per the C&DM Plan are delivered to the customer on the specified due date with a high degree of accuracy. Contractor reviews Progress Report with ESSP Program Manager in a timely manner.

Satisfactory: The ESSP additional reports per the C&DM Plan are delivered to the customer on the specified due date with minimum errors. Contractor reviews Progress Report with ESSP Program Manager.

Poor: The ESSP additional reports per the C&DM Plan do not meet requirements as described in section 2.2 of this document. The Progress Report is not delivered on the specified date and is not reviewed with the ESSP Program Manager.

Unsatisfactory: No ESSP additional reports per the C&DM Plan are delivered to the customer, and the ESSP Program Manager has not given a waiver.

3. Government Furnished Items:

Only specialized computer equipment and associated software needed to perform the duties of this task will be provided as the need arises. Other computer resources shall be provided by the Contractor.

4. Other Essential Information:

(1) Travel will be required.

(2) Special training may be required from time to time. The Technical Monitor will review the training requirements and coordinate the requirements with the Contractor with the appropriate rationale.

(3) Due to schedule critical program activity, the Contractor may need to work beyond the normal work schedule with reasonable compensatory allowances to maintain personal safety and health.

5. Security Clearance: N/A

6. Period of Performance:

Planned start date: [TD1]February 26, 2008 Completion date: [R1]~~February 15, 2009~~ ***February 15, 2010***

7. NASA Task Management:

Technical Monitor (Required): **Gwen Leach**
M/S: 466 Phone: 864-7550

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 002C1-NNL08AM12T Revision: 0 Change: 0 Date: January 17, 2008

Title: Transonic Wind Tunnel Test of 0.8 Scale MLAS

1. Purpose, Objective, or Background (Optional)

The NASA Engineering and Safety Center (NESC) Max Launch Abort System Project (MLAS) has the goal of demonstrating the feasibility of an alternate launch abort system design as risk mitigation for the Crew Exploration Vehicle (CEV) Launch Abort System (LAS). This project is conducted by the NESC team approach to working technical problems. The project is composed of the Project Manager (Mr. Ralph Roe) and team members who are Government personnel from several NASA Centers, as well as independent technical consultants and contractors.

The MLAS project requires subsonic and transonic aerodynamic data to develop an aerodynamic database for the ascent and coast phases of the flight test vehicle over a Mach range of 0.2 to 0.95. To gather this data, the MLAS project has identified the Calspan Transonic Wind Tunnel at Buffalo, New York as having the capability to perform the testing within the schedule constraints of the program. The test would occur over an approximately two-week period of time between March 3 and March 21, depending on specific tunnel availability. An 8% scale wind tunnel model will be provided for testing.

Technical Direction 1 (2/5/08): Reverses the Technical Monitor and Alternate POC roles (see [TD1] Section 7, below).

Technical Direction 2 (2/5/08): Removes the requirement for Contractor to provide fins (see [TD2] below).

Technical Direction 3 (2/25/08): Updates the initial task order start date to February 25, 2008 as issued by the CO on 2/24/08 and updates the schedule to correspond to the approved task plan (see [TD3] below).

Technical Direction 4 (4/15/08): Increases tunnel testing time as authorized by the Contracting Officer's 4/9/08 email (see [TD4] below, Section 4).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

The Contractor is being tasked to procure test services to perform aerodynamic wind-tunnel testing and to provide oversight for the actual test on a time and materials basis. A transonic wind tunnel test covering the Mach range of 0.2 to 0.95 that allows the use of an existing model and balance hardware is required. The test matrix is attached. [TD2]~~The Contractor is also being asked to~~ NASA will provide 8% scaled fins.

2.1 (Requirement/subtask number one):

The Contractor shall provide a pre-test operational plan. The Contractor shall develop a test plan that describes approach and procedures that will be used. This plan includes a brief written description of the general approach that will be used, any required wind-tunnel apparatus configuration changes required, the coordinate system to be used, key data parameters to be measured during test and any changes that may be recommended to the test matrix. The plan must be approved by the Task Monitor: Dave Schuster before proceeding. The Contractor shall also provide the MLAS Aerodynamics Team with model/sting requirements for entry in the transonic tunnel.

2.1.1 Milestones (Optional):

N/A

2.1.2 Deliverables and Schedule (Required):

a. Provide model/sting requirements for entry in the transonic tunnel by [TD3]February 27, 2008.

b. Provide a test plan to the Task Monitor for approval by [TD3]March 15, 2008.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Deliverable date is met

Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent schedule slippage, hardware incompatibility or bad test data.

Begin [TD2] deletion

~~2.2 (Requirement/subtask number two):~~

~~The Contractor shall acquire fins for the physical test models. The Contractor shall oversee the build of 8% scale fins for the physical wind-tunnel test model to be used. This includes acquisition of any hardware materials or services required. Four fins are required to attach to the main model body and four fins are required to attach to the aft body. Fins should be designed according to government provided geometries and must attach in specified locations. Fins become part of the physical model and are the property of the government. The Contractor shall be responsible for proper geometry, materials, placement, and quality and shall be responsible for coordination between the fin provider and the main model provider to assure consistent interfaces.~~

~~2.2.1 Milestones (Optional):~~

~~N/A~~

~~2.2.2 Deliverables and Schedule (Required):~~

~~a. Provide fins for the physical test models at least 1 week prior to wind tunnel entry date.~~

~~2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds):~~

~~Meets: Deliverable date is met.~~

~~Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent schedule slippage, hardware incompatibility or bad test data.~~

End [TD2] deletion

2.3 (Requirement/subtask number three):

The Contractor shall provide the wind tunnel facility and personnel to assemble and install the model hardware and perform the test matrix. The Contractor shall be present during model assembly, installation and configuration changes. The Contractor shall perform wind tunnel test per test matrix for the force and moment testing and flow angularity evaluations preferably during the period from March 3, 2008 to March 21, 2008, depending on tunnel availability. The Contractor shall oversee and be present for the overall execution of the test matrix within the approved test plan. Additional 'testing of opportunity' for improved understanding of aerodynamic performance or related MLAS vehicle performance is allowable provided the test matrix within the approved test plan has been met to the extent possible and scheduled wind-tunnel time remains available. The Contractor shall coordinate with Calspan to provide any required configuration changes to the wind-tunnel test apparatus as deemed necessary during testing according to the approved test plan. The Contractor shall provide an adapter to

attach the GFE force balance to an existing wind tunnel sting.

2.3.1 Milestones (Optional):
N/A

2.3.2 Deliverables and Schedule (Required):
a. Provide the wind tunnel facility and personnel to assemble and install the model hardware in preparation for and during the tunnel entry.
b. Perform test matrix during tunnel entry.
c. Provide oversight and be present for the overall execution of the test matrix within the approved test plan during tunnel entry.
d. Provide any required configuration changes to the wind-tunnel test apparatus as deemed necessary during testing according to the approved test plan.
e. Provide an adapter to attach the GFE force balance to an existing wind tunnel sting at least one week prior to the tunnel entry date.

2.3.3 Performance Metrics/Standards (Required - Meets, Exceeds):
Meets: Deliverable date is met.
Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent schedule slippage, hardware incompatibility or bad test data.

2.4 (Requirement/subtask number four):
The Contractor shall acquire and transmit test data. The Contractor shall provide the MLAS Aerodynamic Team with data acquired during execution of the test matrix in a mutually agreed data format and via electronic media such as on compact disc. Plots of key test results shall be provided in MS Excel or other mutually agreed upon format as soon as possible during the test or immediately following the test.

2.4.1 Milestones (Optional):
N/A

2.4.2 Deliverables and Schedule (Required):
a. Provide the MLAS Aerodynamic Team with data acquired during execution of the test matrix, including plots of key test results, as soon as possible during the test or immediately following the test.

2.4.3 Performance Metrics/Standards (Required - Meets, Exceeds):
Meets: Deliverable date is met.
Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent schedule slippage, hardware incompatibility or bad test

data.

2.5 (Requirement/subtask number five):

The Contractor shall provide transportation of the physical model between LaRC and the tunnel location. The physical model shall include the fins provided by [TD2]~~the Contractor~~ NASA. Any disassembly, reassembly or packaging required to box and ship the model shall be provided as well.

2.5.1 Milestones (Optional):

N/A

2.5.2 Deliverables and Schedule (Required):

a. Provide packaging and transportation of physical test model to and from LaRC and tunnel location within 1 week prior to and following the tunnel test period.

2.5.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Deliverable date is met.

Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent model damage, hardware incompatibility or schedule slippage.

2.6 (Requirement/subtask number six):

The Contractor shall deliver finalized test data to the MLAS Aerodynamics Team within 2 weeks following completion of the test. The Contractor shall provide initial interpretation and documentation of test data relative to improve understanding of aerodynamic performance of the flight test vehicle during ascent and coast phases of flight. Interpretation of any other key results obtained shall also be included.

2.6.1 Milestones (Optional):

N/A

2.6.2 Deliverables and Schedule (Required):

a. Deliver finalized test data to the MLAS Aerodynamics Team within 2 weeks following completion of the test.

b. Provide initial interpretation and documentation of test data within 1 week following completion of the test.

b. Deliver a Power Point presentation describing the overall test and key results within 2 weeks following completion of the test.

2.6.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Deliverable date is met.

Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and

solutions proposed early enough to prevent model damage, hardware incompatibility or schedule slippage.

2.7 (Requirement/subtask number seven):

The Contractor shall provide documentation and interpretation of results. The Contractor shall provide a final written report documenting overall test, including photos, and interpretation of data. The written report shall be in MS Word format. The report shall cover the overall test plan and shall include interpretation of key test results relative to improved understanding of aerodynamic performance of the flight test vehicle during ascent and coast phases of flight and any other key results obtained.

2.7.1 Milestones (Optional):

N/A

2.7.2 Deliverables and Schedule (Required):

a. Provide a final written report documenting overall test and interpretation of data within 1 month following completion of the test.

2.7.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Deliverable date is met.

Exceeds: The Contractor will exceed the required metrics if problems and issues are identified and solutions proposed early enough to prevent schedule slippage and/or if configuration changes are recommended to improve aerodynamic performance.

2.8 (Requirement/subtask number eight) - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.8.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.8.2 Required date: Ongoing.

2.8.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management

walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

1. Physical test model (without fins), force balance, balance taper and thread gages.
2. Appropriate MLAS documentation will be provided by the government for use by the contractor to develop deliverables. This is to include fin design/definition, placement and interface requirements.

4. Other Essential Information:

While much work and communication will be conducted electronically and by telephone, contractor representatives will be required to travel to and from the wind tunnel test site. They will be required to travel to support test planning, implementation, and data analysis and reporting. Specific locations for this travel will include, but are not limited to, NASA's Langley Research Center (LaRC) and the Calspan Transonic Wind Tunnel.

TD4> ***As authorized by the Contracting Officer's 4/9/08 email, the Contractor shall increase tunnel time not to exceed the cost estimate of $56K.*** <TD4

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

No special handling issues.

6. Period of Performance:

Planned start date: TD3 February 25, 2008 Completion date: May 31, 2008

7. TD1 NASA Task Management:

Technical Monitor (Required):

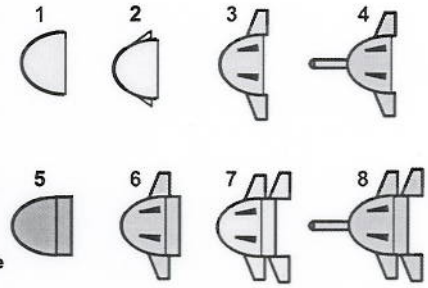
Jessica A. Woods-Vedeler
M/S: 102 Phone: 757-864-2829
Email: Jessica.A.Woods-Vedeler@nasa.gov Fax: 757-864-2464

Other POC (Optional):

David M. Schuster
M/S: 431 Phone: 757-864-2259
Email: David.M.Schuster@nasa.gov Fax: 757-864-2464

8-Jan-08

Coast & Reorientation Phase Configurations	
1	Clean
2	Clean + Nozzles
3	Clean + Nozzles + FWD Fins
4	Clean + Nozzles + FWD Fins + Spike
Abort Configurations	
5	Clean + Aft Cylinder
6	Clean + Nozzles + FWDFins + Aft Cylinder
7	Clean + Nozzles + FWDFins + Aft Cylinder + AFT Fins
8	Clean + Nozzles + FWDFins + Aft Cylinder + Aft Fins + Spike



Config	Model Orient	Nozzles	Abort Fins	Spike	Aft Cylinder	Boost Fins	Alpha, deg	Yaw, deg	Roll, deg	0.2	0.3	0.4	0.45	0.5	0.55	0.6	0.7	0.8	0.9	0.95	Total Runs	Total test Runs
CLEAN																						
1	0	OFF	OFF	OFF	OFF	OFF	-5 to 40	0	0		1	1		1			1		1		5	
							-1	0 to 10	0		1	1		1			1		1		5	
							0	0 to 10	0		1	1		1			1		1		5	
							2	0 to 10	0		1	1		1			1		1		5	
							5	0 to 10	0		1	1		1			1		1		5	
							10	0 to 10	0		1	1		1			1		1		5	
							15	0 to 10	0		1	1		1			1		1		5	
							20	0 to 10	0		1	1		1			1		1		5	
							25	0 to 10	0		1	1		1			1		1		5	
							30	0 to 10	0		1	1		1			1		1		5	
							-5 to 40	0	0		1			1			1		1		4	
																					54	54
0.5 HOUR CHANGE CONFIGURATION 2																						
CLEAN + NOZZLES																						
2	0	ON	OFF	OFF	OFF	OFF	-5 to 40	0	0		1			1			1		1		4	
							-1	0 to 10	0		1	1		1			1		1		5	
							0	0 to 10	0		1	1		1			1		1		5	
							2	0 to 10	0		1	1		1			1		1		5	
							5	0 to 10	0		1	1		1			1		1		5	
							10	0 to 10	0		1	1		1			1		1		5	
							15	0 to 10	0		1	1		1			1		1		5	
							20	0 to 10	0		1	1		1			1		1		5	
							25	0 to 10	0		1	1		1			1		1		5	
							30	0 to 10	0		1	1		1			1		1		5	
							-1	0	0 to 45		1	1		1			1		1		5	
							0	0	0 to 45		1	1		1			1		1		5	
							2	0	0 to 45		1	1		1			1		1		5	
							5	0	0 to 45		1	1		1			1		1		5	
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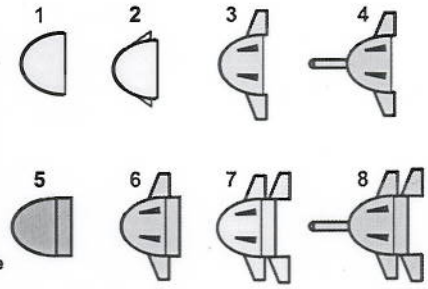
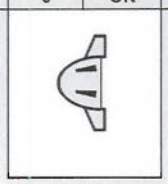
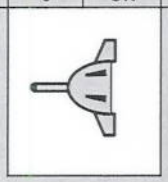
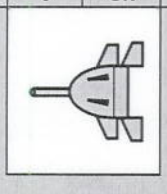
							15	0	0 to 45		1	1		1			1		1		5	
							20	0	0 to 45		1	1		1			1		1		5	
							30	0	0 to 45												0	
							40	0	0 to 45												0	
							-5 to 40	0	0		1			1			1		1		4	
																					88	142
1.5 HOUR CHANGE CONFIGURATION 3 INVERTED																						
CLEAN + NOZZLES + FWD FINS -- BASELINE COAST																						
3	0	ON	ON	OFF	OFF	OFF	-5 to 3	0	0		1	1		1			1		1		5	
																					5	147

8-Jan-08

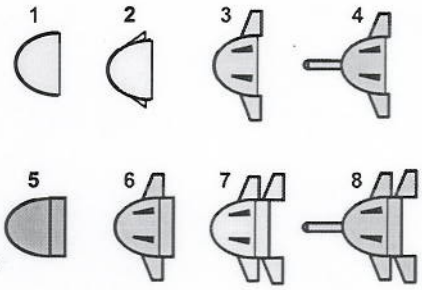
Coast & Reorientation Phase Configurations	
1	Clean
2	Clean + Nozzles
3	Clean + Nozzles + FWD Fins
4	Clean + Nozzles + FWD Fins + Spike
Abort Configurations	
5	Clean + Aft Cylinder
6	Clean + Nozzles + FWDFins + Aft Cylinder
7	Clean + Nozzles + FWDFins + Aft Cylinder + AFT Fins
8	Clean + Nozzles + FWDFins + Aft Cylinder + Aft Fins + Spike

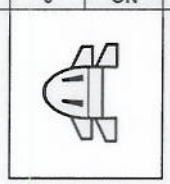
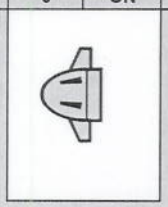


Config	Model Orient	Nozzles	Abort Fins	Spike	Aft Cylinder	Boost Fins	Alpha, deg	Yaw, deg	Roll, deg	0.2	0.3	0.4	0.45	0.5	0.55	0.6	0.7	0.8	0.9	0.95	Total Runs	Total test Runs
0.5 HOUR CHANGE CONFIGURATION 3 UPRIGHT																						
CLEAN + NOZZLES + FWD FINS -- BASELINE COAST																						
3	0	ON	ON	OFF	OFF	OFF	-5 to 40	0	0		1	1	1	1			1		1		6	
							-1	0 to 10	0		1	1		1			1		1		5	
							0	0 to 10	0		1	1		1			1		1		5	
							2	0 to 10	0		1	1		1			1		1		5	
							5	0 to 10	0		1	1		1			1		1		5	
							10	0 to 10	0		1	1		1			1		1		5	
							15	0 to 10	0		1	1		1			1		1		5	
							20	0 to 10	0		1	1		1			1		1		5	
							25	0 to 10	0		1	1		1			1		1		5	
							30	0 to 10	0		1	1		1			1		1		5	
							-1	0	0 to 45		1	1		1			1		1		5	
							0	0	0 to 45		1	1		1			1		1		5	
							2	0	0 to 45		1	1		1			1		1		5	
							5	0	0 to 45		1	1		1			1		1		5	
							10	0	0 to 45		1	1		1			1		1		5	
							15	0	0 to 45		1	1		1			1		1		5	
							20	0	0 to 45		1	1		1			1		1		5	
							30	0	0 to 45												0	
							40	0	0 to 45												0	
							-5 to 40	0	R1		1			1			1		1		4	
																					90	237
0.5 HOUR CHANGE CONFIGURATION 4																						
CLEAN + NOZZLES + FWD FINS + SPIKE																						
4	0	ON	ON	ON	OFF	OFF	-5 to 40	0	0		1	1	1	1	1	1	1	1	1	1	10	
							-1	0 to 10	0		1	1		1			1		1		5	
							0	0 to 10	0		1	1		1			1		1		5	
							2	0 to 10	0		1	1		1			1		1		5	
							5	0 to 10	0		1	1		1			1		1		5	
							10	0 to 10	0		1	1		1			1		1		5	
							15	0 to 10	0		1	1		1			1		1		5	
							20	0 to 10	0		1	1		1			1		1		5	
							25	0 to 10	0		1	1		1			1		1		5	
							30	0 to 10	0		1	1		1			1		1		5	
							-5 to 40	0	0		1			1			1		1		4	
																					59	296
2.5 HOUR CHANGE CONFIGURATION 8																						
CLEAN + NOZZLES + FWD FINS + SPIKE + AFT CYLINDER + AFT FINS -- BASELINE BOOST																						
8	0	ON	ON	ON	ON	ON	-5 to 40	0	0					1	1	1	1	1	1	1	7	
							-1	0 to 10	0					1			1		1		3	
							0	0 to 10	0					1			1		1		3	
							2	0 to 10	0					1			1		1		3	
							5	0 to 10	0					1			1		1		3	
							10	0 to 10	0					1			1		1		3	
							15	0 to 10	0					1			1		1		3	
							20	0 to 10	0					1			1		1		3	
							25	0 to 10	0					1			1		1		3	
							30	0 to 10	0					1			1		1		3	
							-5 to 40	0	0					1			1		1		3	
																					37	333

8-Jan-08

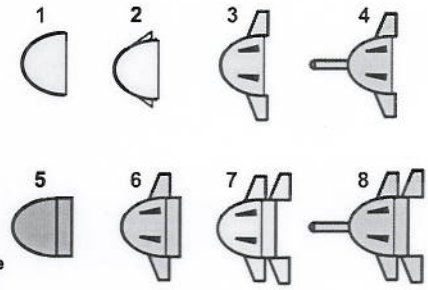
Coast & Reorientation Phase Configurations	
1	Clean
2	Clean + Nozzles
3	Clean + Nozzles + FWD Fins
4	Clean + Nozzles + FWD Fins + Spike
Abort Configurations	
5	Clean + Aft Cylinder
6	Clean + Nozzles + FWDFins + Aft Cylinder
7	Clean + Nozzles + FWDFins + Aft Cylinder + AFT Fins
8	Clean + Nozzles + FWDFins + Aft Cylinder + Aft Fins + Spike



Config	Model Orient	Nozzles	Abort Fins	Spike	Aft Cylinder	Boost Fins	Alpha, deg	Yaw, deg	Roll, deg	0.2	0.3	0.4	0.45	0.5	0.55	0.6	0.7	0.8	0.9	0.95	Total Runs	Total test Runs
0.5 HOUR CHANGE CONFIGURATION 7																						
CLEAN + NOZZLES + FWD FINS + AFT CYLINDER + AFT FINS																						
7	0	ON	ON	OFF	ON	ON	-5 to 40	0	0					1	1	1	1	1	1	1	7	
							-1	0 to 10	0					1			1		1		3	
							0	0 to 10	0					1			1		1		3	
							2	0 to 10	0					1			1		1		3	
							5	0 to 10	0					1			1		1		3	
							10	0 to 10	0					1			1		1		3	
							15	0 to 10	0					1			1		1		3	
							20	0 to 10	0					1			1		1		3	
							25	0 to 10	0					1			1		1		3	
							30	0 to 10	0					1			1		1		3	
							-1	0	0 to 45					1			1		1		3	
							0	0	0 to 45					1			1		1		3	
							2	0	0 to 45					1			1		1		3	
							5	0	0 to 45					1			1		1		3	
							10	0	0 to 45					1			1		1		3	
							15	0	0 to 45					1			1		1		3	
							20	0	0 to 45					1			1		1		3	
							30	0	0 to 45												0	
							40	0	0 to 45												0	
							-5 to 40	0	0					1			1		1		3	
																					58	391
1.5 HOUR CHANGE CONFIGURATION 6																						
CLEAN + NOZZLES + FWD FINS + AFT CYLINDER																						
6	0	ON	ON	OFF	ON	OFF	-5 to 40	0	0					1	1	1	1	1	1	1	7	
							-1	0 to 10	0					1			1		1		3	
							0	0 to 10	0					1			1		1		3	
							2	0 to 10	0					1			1		1		3	
							5	0 to 10	0					1			1		1		3	
							10	0 to 10	0					1			1		1		3	
							15	0 to 10	0					1			1		1		3	
							20	0 to 10	0					1			1		1		3	
							25	0 to 10	0					1			1		1		3	
							30	0 to 10	0					1			1		1		3	
							-1	0	0 to 45					1			1		1		3	
							0	0	0 to 45					1			1		1		3	
							2	0	0 to 45					1			1		1		3	
							5	0	0 to 45					1			1		1		3	
							10	0	0 to 45					1			1		1		3	
							15	0	0 to 45					1			1		1		3	
							20	0	0 to 45					1			1		1		3	
							30	0	0 to 45												0	
							40	0	0 to 45												0	
							-5 to 40	0	0					1			1		1		3	
																					58	449

8-Jan-08

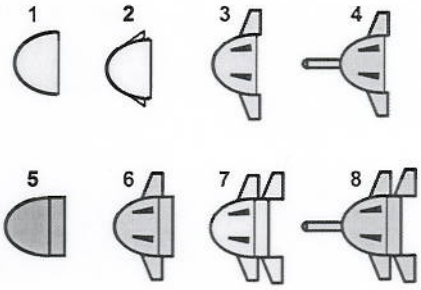
Coast & Reorientation Phase Configurations	
1	Clean
2	Clean + Nozzles
3	Clean + Nozzles + FWD Fins
4	Clean + Nozzles + FWD Fins + Spike
Abort Configurations	
5	Clean + Aft Cylinder
6	Clean + Nozzles + FWDFins + Aft Cylinder
7	Clean + Nozzles + FWDFins + Aft Cylinder + AFT Fins
8	Clean + Nozzles + FWDFins + Aft Cylinder + Aft Fins + Spike



Config	Model Orient	Nozzles	Abort Fins	Spike	Aft Cylinder	Boost Fins	Alpha, deg	Yaw, deg	Roll, deg	0.2	0.3	0.4	0.45	0.5	0.55	0.6	0.7	0.8	0.9	0.95	Total Runs	Total test Runs
1.0 HOUR CHANGE CONFIGURATION 5																						
CLEAN + AFT CYLINDER																						
5	0	OFF	OFF	OFF	ON	OFF	-5 to 40	0	0					1	1	1	1	1	1	1	7	
							-1	0 to 10	0					1			1		1		3	
							0	0 to 10	0					1			1		1		3	
							2	0 to 10	0					1			1		1		3	
							5	0 to 10	0					1			1		1		3	
							10	0 to 10	0					1			1		1		3	
							15	0 to 10	0					1			1		1		3	
							20	0 to 10	0					1			1		1		3	
							25	0 to 10	0					1			1		1		3	
							30	0 to 10	0					1			1		1		3	
							-5 to 40	0	0					1			1		1		3	
																					37	486
2.5 HOUR CHANGE CONFIGURATION 1																						
CLEAN																						
1	45	OFF	OFF	OFF	OFF	OFF	40 to 85	0	0		1	1	1	1							4	
							40 to 85	0	0		1	1	1	1							4	
																					8	494
0.5 HOUR CHANGE CONFIGURATION 2																						
CLEAN + NOZZLES																						
2	45	ON	OFF	OFF	OFF	OFF	40 to 85	0	0		1	1	1	1							4	
							40	0	0 to 45		1	1	1	1							4	
							45	0	0 to 45		1	1	1	1							4	
							50	0	0 to 45		1	1	1	1							4	
							60	0	0 to 45		1	1	1	1							4	
							70	0	0 to 45		1	1	1	1							4	
							80	0	0 to 45		1	1	1	1							4	
							40 to 85	0	0		1	1	1	1							4	
																					32	526
2.0 HOUR CHANGE CONFIGURATION 2																						
CLEAN + NOZZLES																						
2	90	ON	OFF	OFF	OFF	OFF	85 to 130	0	0		1	1	1	1							4	
							85	0	0 to 45		1	1	1	1							4	
							90	0	0 to 45		1	1	1	1							4	
							100	0	0 to 45		1	1	1	1							4	
							110	0	0 to 45		1	1	1	1							4	
							120	0	0 to 45		1	1	1	1							4	
							130	0	0 to 45		1	1	1	1							4	
							85 to 130	0	0		1	1	1	1							4	
																					32	558
0.5 HOUR CHANGE CONFIGURATION 1																						
CLEAN																						
1	90	OFF	OFF	OFF	OFF	OFF	85 to 130	0	0		1	1	1	1							4	
							85 to 130	0	0		1	1	1	1							4	
																					8	566

8-Jan-08

Coast & Reorientation Phase Configurations	
1	Clean
2	Clean + Nozzles
3	Clean + Nozzles + FWD Fins
4	Clean + Nozzles + FWD Fins + Spike
Abort Configurations	
5	Clean + Aft Cylinder
6	Clean + Nozzles + FWDFins + Aft Cylinder
7	Clean + Nozzles + FWDFins + Aft Cylinder + AFT Fins
8	Clean + Nozzles + FWDFins + Aft Cylinder + Aft Fins + Spike



Config	Model Orient	Nozzles	Abort Fins	Spike	Aft Cylinder	Boost Fins	Alpha, deg	Yaw, deg	Roll, deg	0.2	0.3	0.4	0.45	0.5	0.55	0.6	0.7	0.8	0.9	0.95	Total Runs	Total test Runs
1.5 HOUR CHANGE CONFIGURATION 1																						
CLEAN																						
1	135	OFF	OFF	OFF	OFF	OFF	135 to 175	0	0		1	1	1	1							4	
							135 to 175	0	0		1	1	1	1							4	
																					8	574
0.5 HOUR CHANGE CONFIGURATION 2																						
CLEAN + NOZZLES																						
2	135	ON	OFF	OFF	OFF	OFF	135 to 175	0	0		1	1	1	1							4	
							135	0	0 to 45		1	1	1	1							4	
							140	0	0 to 45		1	1	1	1							4	
							150	0	0 to 45		1	1	1	1							4	
							160	0	0 to 45		1	1	1	1							4	
							170	0	0 to 45		1	1	1	1							4	
							135 to 175	0	0		1	1	1	1							4	
																					28	602
2.5 HOUR CHANGE CONFIGURATION 2																						
CLEAN + NOZZLES																						
2	180	ON	OFF	OFF	OFF	OFF	175 to 185	0	0		1	1	1	1							4	
							175	0	0 to 45		1	1	1	1							4	
							180	0	0 to 45		1	1	1	1							4	
							175 to 185	B1	0		1	1	1	1							4	
																					16	618
0.5 HOUR CHANGE CONFIGURATION 1																						
CLEAN																						
1	180	OFF	OFF	OFF	OFF	OFF	175 to 185	0	0		1	1	1	1							4	
							175 to 185	0	0		1	1	1	1							4	
																					8	626

1. Purpose, Objective, or Background (Optional)

An objective of this task is to provide statistical analyses of aviation incidents and accidents to identify statistically significant trends 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 effort supports one ASAB's main customers: the Aviation Safety Program (AvSP).

Technical Direction 1 (2/22/08): Updates the initial task order start date to February 15, 2008 as issued by the CO on 2/15/08 (see [TD1] below, Section 6).
Revision 1 (12/9/08): Includes update to deliverable 2.12(d), adds deliverable 2.12(f), and extends period of performance four months to January 31, 2010. (see [R1] below)
Revision 2 (5/19/2009): Extends the period of performance 13 months to February 28, 2011 with updated/added requirements for subtasks 2.12(d) through 2.12(i) and elimination of optional POC (see [R2] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):
The Contractor shall support the Aviation Safety (AvSafe) Program and the Joint Planning and Development Office (JPDO) by providing:

a) Analyses of historical aviation accident, incident and or/ operational data to identify statistically significant trends related to AvSafe Program technologies using the ASAB's SAS software.

b) Regression analyses of historical aviation accident, incident and or/ operational data to identify any possible overlooked issues in aviation safety using the ASAB's SAS software.

c) SAS data and text mining of historical aviation accident, incident and or/ operational data to validate the output of ASAB safety related operations research (e.g., simulation, decision support) models.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Report containing descriptive statistics, summary and graphical representation of propulsion related aviation safety data analysis results. Due by: March 31, 2008

c) Report containing causal factors, descriptive statistics, summary and graphical representation of loss of control and/or other aviation safety related statistical data trend analysis results. Due by: June 30, 2008

d) [R1>]Complete report describing results of the update of the aviation accident and incident

databases located in ASAB. Report shall summarize key enhancements to the ASAB databases and include descriptive statistics and graphical representations of these enhancements. Due by: March 30, 2009<R1

e) R2> ***Report containing descriptive statistics, summary and graphical representation of NTSB/FAA statistical and prognostic data analysis results in support of the Integrated Vehicle Health Management (IVHM) Project. Report shall contain additions and changes to the set of accident, incidents and causal factors related to IVHM.*** <R2 Due by: August 28, 2009

Begin R1 block addition

f) R2> ***Report containing descriptive statistics, summary and graphical representation of baseline fatal accident rate analysis results as part of the Integrated Resilient Aircraft Control (IRAC) portfolio assessment. Due by: November 30, 2009*** <R2

End R1 block addition

*****Begin R2 block addition*****

g) Report containing descriptive statistics, summary and graphical representation of NTSB/FAA statistical and prognostic data analysis results in support of the Integrated Vehicle Health Management (IVHM) Project. Report shall contain additions and changes to the set of accident, incidents and causal factors related to IVHM. Due by: May 31, 2010

h) Report containing descriptive statistics, summary and graphical representation of baseline fatal accident rate analysis results as part of the Integrated Vehicle Health Management (IVHM) portfolio assessment. Due by: August 30, 2010

i) Report containing descriptive statistics, summary and graphical representation of NTSB/FAA statistical and prognostic data analysis results in support of the Integrated Vehicle Health Management (IVHM) Project. Report shall contain additions and changes to the set of accident, incidents and causal factors related to IVHM. Due by: February 28, 2011

*****End R2 block addition*****

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds):

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. This includes briefings of results to Aviation Safety Program and JPDO colleagues. 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).

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

A. Existing specialized analysis, processing, and/or design tools
B. Existing models, databases, geometry, data descriptions, and/or test data
C. Computer workstations and CPU time

4. Other Essential Information:

NOTE: The Contractor shall place no restrictions on NASA's use or distribution of the models/codes produced under this contract nor distribute them to other parties without NASA's permission.

Note: These codes will only be used for performing the work under this contract and cannot be used for any other purpose or distributed without the permission of NASA, Langley. The Contractor is required to sign a Software Usage Agreement.

5. Security Clearance:

6. Period of Performance:

Planned start date: [TD1]February 15, 2008 Completion date: [R1]~~August 31, 2009~~ [R2]~~January 31, 2010~~ ***February 28, 2011***

7. NASA Task Management:

Technical Monitor (Required): Jeffrey Viken
M/S: 442 Phone: 757-864-2875
[R2]**Other POC (Optional):**
M/S: Phone:

TASK ORDER NUMBER: 068D3-NNL08AM14T Revision: 0 Change: 0 Date: March 3, 2008

Title: Shell Analysis and Design Tool - Buckling Knockdown Factor

1. Purpose, Objective, or Background (Optional)

Shell Analysis and Design Tool Development, Verification and Validation to Support Shell Buckling Knockdown Factor Program (SBKF)

Technical Direction 1 (3/31/08): Updates the initial task order start date to March 31, 2008 as issued by the CO on 3/28/08 (see [TD1] below, Section 6).

Technical Direction 2 (3/13/09): Curtails the period of performance to March 13, 2009 as issued by the CO on 3/13/09 (see [TD2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. Specific deliverables and due dates will be clarified in the NOCs.

2.1 (Requirement/subtask number one): (NOC)

The Contractor shall develop, verify, validate and implement linear and nonlinear analyses methods and equations for thin-walled shell structures as indicated in NOCs. For example, develop analysis tools for predicting the buckling and post-buckling of composite and metallic stiffened and un-stiffened shells of revolution subjected to combined mechanical, thermal, and pressure loads. The Contractor shall develop and implement efficient solution strategies, verify coded mathematics and validate predicted results with available test data in the literature and/or with higher fidelity analyses

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

2.1.2.1 develop, verify and validate analysis tools for predicting the buckling behavior of composite and metallic stiffened and un-stiffened shells of revolution subjected to combined mechanical, thermal, and pressure loads. Due as clarified in NOCs and in coordination with Technical Monitor. Depending on technical progress, some dates may have to be adjusted periodically.

2.1.2.2 develop , verify and validate analysis tools for predicting the post-buckling behavior of composite and metallic stiffened and un-stiffened shells of revolution subjected to combined mechanical, thermal, and pressure loads. Due as clarified in NOCs and in coordination with Technical Monitor. Depending on technical progress, some dates may have to be adjusted periodically.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

meets: the deliverables are verified and validated with respect to existing data and known solutions, the analysis tools are made fully compatible with other existing Structural Mechanics and Concepts Branch (SMCB) tools

exceeds: all deliverables are completed ahead of schedule

2.2 (Requirement/subtask number two): (NOC)

The Contractor shall perform thorough reviews of technical publications on relevant shell analysis and testing and obtain data for analysis tool development and validation in support of task 1#.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

2.2.2.1 NASA-CR summarizing the state-of-the art in shell analysis/design and validation testing as it pertains to the Shell Buckling Knockdown Factor program. Specifically, buckling and post-buckling behavior of composite and metallic shells of revolution subjected to combined mechanical and pressure loads. Due dates shall be established in coordination with Technical Monitor at points of significant progress.

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

meets: publication of NASA-CR on shell buckling state-of-the-art
exceeds: delivery ahead of the established date without impact to quality of report

2.3 (Requirement/subtask number three): (NOC)

The Contractor shall support code and graphical user interface development and verification in support of task #1 by providing analysis code that is compatible with existing tools.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

2.3.2.1 analysis and design tools as described in 2.1 that are compatible with existing SMCB analysis and design software. Due dates shall be established in coordination with Technical Monitor at points of significant progress.

2.3.2.2 verify integration of said analysis and design tools into existing SMCB analysis and design software. Due dates shall be established in coordination with Technical Monitor at points of significant progress.

2.3.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: on time delivery and verification of analysis and design tools

Exceed: early delivery and verification of analysis and design tools

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.4.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): none

6. Period of Performance:

Planned start date: TD1 3/31/08 Completion date: TD2 ~~9/30/10~~ ***3/13/09***

7. NASA Task Management:

Technical Monitor (Required): Mark W. Hilburger

M/S: 190 Phone: (757) 864-3106

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 018D2-NNL08AM15T Revision: 1 Change: 0 Date: October 9, 2008

Title: Test & Verification Support to Constellation Program Level II Integrated Loads, Structures, & Mechanisms (ILS&M) Systems Integration Group (SIG)

1. Purpose, Objective, or Background (Optional)

In order to assist NASA's Constellation Program (CxP) in the rapid and successful development of the Orion Crew Exploration Vehicle (CEV), Ares I Crew Launch Vehicle (CLV), Ares V Cargo Launch Vehicle (CaLV), Lunar Surface Access Module (LSAM), and Earth Departure Stage (EDS) and control downstream costs including the reduction of design changes, an accurate set of requirements meeting all NASA standards (e.g., requirements shall be traceable, verifiable, unambiguous, etc.), should be developed to address all structural subsystems. The development, design, testing and evaluation (DDT&E) of the CEV, CLV, CaLV, LSAM, and EDS requires developing an early set of structures requirements that address the following:

1) Analyses (static, structural dynamics and vibro-acoustic) in support of the design of structures including ground assembly, transportation, launch, on-orbit operations, lunar travel, lunar landing, lunar operations, and earth re-entry.
2) Integration of loads from other disciplines (GN&C, thermal, aerodynamic and aerothermal) into the overall loads history.
3) Integrated analysis and tests of the CEV coupled with CLV, CEV coupled with LSAM, CEV coupled with EDS, and CEV coupled with International Space Station (ISS) should be addressed, and the minimum cost solutions that are technically viable should be recommended.
4) Combination of loads due to various sources and environments at all phases of development should be addressed. Appropriate factors of safety for load combinations should be studied/analyzed to ensure that load combinations are neither non-conservative nor overly conservative and appropriate recommendations should be made.
5) Requirements for qualification and acceptance tests of structural substystems and components should be defined for static, dynamic, and vibro-acoustic loads. Test requirements should also be addressed to ensure that laboratory facilities and test equipment are adequate to meet test objectives.
6) Survey of Government and US industry facilities should be performed for modal survey tests, static structural tests, vibro-acoustic tests, and thermal vacuum tests.
7) The possibility of utilizing a dynamic scale model program, as was used in some prior NASA Programs such as Shuttle, for developing verified analytical models, should be explored.

In addition to the development and maintenance of system-level requirements, assessment of the system-level test program with respect to verification of the requirements, identification of system-level analyses, and mitigation of system-level program risks must be performed.

The Government anticipates that the level of effort required for this Work Statement is 1.0 WYE.

Technical Direction 1 (5/9/08): Updates the initial task order start date to May 7, 2008 as issued by the CO on 5/7/08.
Revision 1 (10/09/08): Extends the period of performance 11 months to November 30, 2009 in continuation of NASA's support (see [R2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 The scope of this PWS is to provide test and verification support to the Constellation Program (CxP)

Level II ILS&M SIG as the CxP prepares for the different Level III Preliminary Design Reviews. This support will primarily be in the areas of developing the overall verification process for ILS&M SIG requirements and flowing this information into the Cx Systems Integration Plan (SIP), reviewing the Change Requests to CxP documentation, and assisting with developing plans for Level II structural testing and the necessary justifications for the subject test programs. As the program requirements continue to mature, support will also be required for identifying structural test requirements and reviewing structural test plans.

2.1.1 The Contractor shall perform the following requirements:

a) Provide technical assistance to the Integrated Loads, Structures, & Mechanisms (ILS&M) System Integration Group (SIG) in defining, integrating and coordinating with the CxP Level III projects the structural requirements and associated verifications for CEV, CLV, CaLV, LSAM, and EDS. This technical assistance involves assessing impacts and risks to CxP by Level III submitted deviations and waivers to structural, loads, and material & processes requirements.

b) Provide technical assistance/guidance in developing the overall verification process to include the Level II/III inputs required for verification of ILS&M SIG requirements, overall schedule to include milestones, and linkages between the Cx Master Integration & Verification Plan (MIVP) and Cx SIP.

c) Provide technical assistance in developing/reviewing/maintaining requirements and verifications for the Level II Interface Requirements Documents (IRDs) for the interfaces shared between Level III Projects.

d) Represent ILS&M SIG in Structural Test Integration Group (STIG) and Flight Test Working Group (FTWG) meetings and technical interchange meetings (TIMs).

e) Provide support for ILS&M SIG technical risk identification and mitigation.

f) Provide support to ILS&M SIG in presentations and reviews.

2.1.2 Deliverables and Schedule:

a) Charts, tables, documents, and electronic media documenting contractor contributions to risk identification and mitigation. Ongoing
b) Charts, tables, documents, and electronic media documenting requirements verification & test verification requirements (TVR) development in support of Cx Systems Integration Plan (SIP) development. Ongoing
c) Charts, tables, documents, and electronic media documenting requirements and verification tasks in support of Interface Requirements Documents (IRD) refinement. Ongoing
d) Charts, tables, documents, and electronic media documenting results of tasks associated with the STIG and FTWG meetings/TIMs. Ongoing

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets – The Contractor will meet the metrics/standards if all established milestones are met by the required due date.

Exceeds – The Contractor will exceed the metrics/standards if all established milestones are met by

the required due date and 50% of milestones are met at least one week early.

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

In the event of episodic on-site LaRC access is required, the Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Government will furnish or make available to the Contractor any documentation deemed necessary by the Government to accomplish this task.

4. Other Essential Information:

The Government does not require on-site support for this task.

5. Security Clearance:

None Needed

6. Period of Performance:

Planned start date: TD1 5/7/2008 Completion date: R1 ~~12/31/2008~~ ***11/30/09***

7. NASA Task Management:

Technical Monitor (Required): **Scott A. Hill**
M/S: 431 Phone: 4-7029

Other POC (Optional): **David M. McGowan**
M/S: 431 Phone: 4-4916

TASK ORDER NUMBER: 001C4-NNL08AM16T Revision: 1 Change: 0 Date: July 28, 2008

Title: Earned Value Management Support for Systems Management Office

1.0 PURPOSE, OBJECTIVE, OR BACKGROUND:

The LaRC Center Director has directed Systems Management Office (SMO) to pursue the proper application of integrated program management disciplines as the Earned Value Management (EVM) action office. The Contractor will support SMO on implementation matters pertaining to EVM.

The successful application of Integrated Program Management (IPM) is comprised of a set of program management disciplines that integrates the technical, cost, and schedule parameters of a project. The center piece of this set of program management disciplines is the implementation of EVM. During the project planning phase, an integrated baseline is developed by time phasing budget resources for defined work. As work is performed and measured against the baseline, the corresponding budget value is "earned". From this *earned value* metric, cost and schedule variances can be determined and analyzed. From these basic variance measurements, the Center Sub-Element Project Manager (PM) can identify significant drivers, forecast future cost and schedule performance, and construct corrective action plans to mitigate the predicted adverse trend(s). EVM therefore encompasses both performance measurement (i.e., what is the program status) and performance management (i.e., what we can do about it).

Technical Direction 1 (5/9/08): Updates the initial task order start date to May 8, 2008 as issued by the CO on 5/7/08 (see [TD1] below, Section 6).

Revision 1 (7/28/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with clarifications, formatting changes, and completed work annotated (see [R1] below). Note: For historical details deleted for clarity and/or convenience see previous version of this PWS located on the electronic task order system (ETOS).

2.0 DESCRIPTION OF THE WORK TO BE PERFORMED: (See LMS-CP-5523, Appendix A)

Specific tasking will originate from the SMO but may involve other organizations (see included references to other organizations' potential involvement in the requirements below). The Contractor shall support the following identified tasking by providing oversight, guidance, and programmatic support to each of the following initiatives.

2.1 Task Descriptions

Task 1) Planning Process Improvement

a. The Contractor shall identify and evaluate the Center's "Planning Processes" relative to EVM and the principles of "The Process Planning Group" (as defined by *PMBOK*® Guide Third Addition 9 – ANSI/PMI 99-001-2004, section 3.2.2).

Specifically the following requirements will be needed by SMO on an episodic basis:

b. The Contractor shall provide recommendations to the SMO relative to the definition, creation, and application of integrated program and project management disciplines/functions to mitigate any material deficiencies identified in the Center's Planning Processes.
c. The Contractor shall evaluate and report on the implementation of the Center's Planning Processes by specific program, project, or organization.
d. The Contractor shall provide recommendations relative to the definition, creation, and application of corrective measures necessary to mitigate any material deficiencies identified in the implementation of the Center's Planning Processes by a specific program, project, or organization.

Task 2) Monitoring and Controlling Process Improvement

a. The Contractor shall identify and evaluate the Center's "Monitoring and Controlling Processes" relative to the principles of "The Monitoring and Controlling Process Group" (as defined by *PMBOK*® Guide Third Addition 9 - ANSI/PMI 99-001-2004, section 3.2.4).

Specifically the following requirements will be needed by SMO on an episodic basis:

b. The Contractor shall provide recommendations to the SMO relative to the definition, creation, and application of integrated program and project management disciplines/functions to mitigate any material deficiencies identified in the Center's Monitoring and Controlling Processes.
c. The Contractor shall evaluate and report on the implementation of the Center's Monitoring and Controlling Processes by

specific program, project, or organization.

d. The Contractor shall provide recommendations relative to the definition, creation, and application of corrective measures necessary to mitigate any material deficiencies identified in the implementation of the Center's Monitoring and Controlling Processes by a specific program, project, or organization.

Task 3) Continuity of Operations during the transfer of EVM related responsibilities: [R1] ***(Completed)***

Task 4) EVM Consulting Activities supporting Task 1 & 2:

a. The Contractor shall identify the best of breed/leading EVM practices from the public/private sector, consistent with *PMBOK* ® Guide Third Addition 9 - ANSI/PMI 99-001-2004, and use the resultant as a basis of measurement to evaluate the Center's EVM processes for effectiveness, efficiency, and compliance with those defined practices.
b. The Contractor shall report findings to the SMO and, on occasion, shall be prepared to present summaries of their findings to other organizations at the Center.
c. The Contractor shall develop and propose solutions that include elimination of redundant, duplicative, or unnecessary processes and roles within Center environment that do not provide value to program/project execution. In other instances the Contractor shall propose solutions where process capabilities do not exist and recommend commensurate process capability establishment.
d. On occasion, the Contractor shall develop plans for the export of these processes, systems, and organizational changes across the Center.
e. On occasion, the Contractor shall provide direct EVM related consultation support to specific programs, projects, and organizations to facilitate the implementation of EVM Process Improvement efforts adopted by the Center.

Task n) Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.2 Deliverables and Schedule (Required):

Work on Revision 1 is planned to begin on January 1, 2009 (contingent upon the placement of funds on the contract) and to conclude on December 31, 2009. Specific deliverables and completion dates for the work breakdown elements are given below.

Item	Description	Schedule
Tasks 1-4	Meeting Minutes and Presentations: The Contractor shall facilitate project meetings, conference calls and video teleconferences, develop briefings on occasion to support these meetings, and produce minutes to document the proceedings and record the decisions and agreements made by the participants.	10 work days after meeting date, through December 31, 2009.
Tasks 1,2,4	Executive Briefings and Reports[*1]: The Contractor shall prepare briefings, summaries, and information papers to document and communicate the analyses, conclusions or recommendations of these leadership teams and delegated Sub-teams.	Within 5 work days prior to negotiated date needed, through December 31, 2009.
	Project Execution Support Package[*1]: The Contractor shall provide support to Sub-teams designated by the SMO in the collection and analysis of project-related data and transforming that data into	Within 20 work days of project commitment, through December 31, 2009.

	information. The Contractor will provide and apply project management tools and templates to support project activities. In addition, the Contractor will perform benchmark studies, action item tracking and risk monitoring, project artifact identification, and configuration management of those artifacts as applicable.	changes agreed to between SMO and other respective Center Leadership/Managers.
Tasks 1,2,4	Plan of Action & Milestones*1: The Contractor shall prepare and maintain Plans of Action and Milestones (POA&Ms) for all tasking and associated initiatives.	Within 20 work days of project commitment, through December 31, 2009. These deliverables and schedule are dependent upon negotiated project process changes agreed to between SMO and other respective Center Leadership/Managers.
Tasks 1,2,4	Project Management Review*1: The Contractor shall facilitate Project Management Reviews (PMR) addressing cost, schedule and performance; discussing progress from and issues arising since the last review and recommendations for the way ahead.	10 work days after financial month ends (post project commitment), through December 31, 2009.
Tasks 1,2,4	Monthly Status Report: The Contractor shall provide ongoing contract activity status to include planned versus actual task completion, outstanding issues and recommendations. The Contractor will describe services provided, travel in support of the contract, and anticipated activity for the next reporting period.	10 work days after financial month ends (post project commitment), through December 31, 2009
Task n	Prevention and correction actions of cited findings from NASA management walkthroughs and reportable incidents.	Ongoing, through December 31, 2009

Note *1: These Contractor deliverables and schedule are dependent upon negotiated project process changes agreed to between SMO and other respective Center Leadership/Managers.

2.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Item (tasks 1 – n)	Required	Meets	Exceeds
Tasks 1,2,4 Meeting Minutes and Presentations	10 work days after meeting date	Delivered On Time	Delivered Early
Tasks 1,2,4 Executive Briefings and Reports	Within 5 work days prior to negotiated need date	Delivered On Time	Delivered Early
Tasks 1,2,4 Project Execution Support Package	Within 20 work days of project commitment	Delivered On Time	Delivered Early
Tasks 1,2,4	Within 20 work days of project	Delivered On Time	Delivered Early

Plan of Action & Milestones	commitment		
Tasks 1,2,4 Project Management Review	10 work days after financial month end (post project commitment)	Delivered On Time	Delivered Early
Tasks 1,2,4 Monthly Status Report	10 work days after financial month end (post project commitment)	Delivered On Time	Delivered Early
Task n	Meets Work Environmental Safety and Organizational Standards	No repeated findings or incidents in the six-month award fee period.	No cited findings or reportable incidents in the six-month award fee period.

2.3 SUB-TASKS DESCRIPTIONS:

The Contractor shall perform the following sub-tasks, resulting in the specified deliverables:

a: MEETING FACILITATION: The Contractor shall facilitate project meetings, conference calls and video teleconferences, develop briefings on occasion to support these meetings, and produce minutes to document the proceedings and record the decisions and agreements made by the participants. [Meeting Minutes and Presentations]

b: EXECUTIVE COMMUNICATIONS: The Contractor shall prepare briefings, summaries, and information papers to document and communicate the analyses, conclusions or recommendations of these leadership teams and delegated Sub-teams. [Executive Briefings and Reports]

c: PROJECT EXECUTION SUPPORT: The Contractor shall provide support to Sub-teams designated by the SMO in the collection and analysis of project-related data and transforming that data into information. The Contractor shall provide and apply project management tools and templates to support project activities. In addition, the Contractor shall perform benchmark studies, action item tracking and risk monitoring, project artifact identification, and configuration management of those artifacts as applicable. [Project Execution Support Package]

d: PROJECT MANAGEMENT: The Contractor shall prepare and maintain Plans of Action and Milestones (POA&Ms) for all tasking and associated initiatives. [R1] ***[Plans of Action and Milestone]***

e: PROJECT REPORTING The Contractor shall facilitate Project Management Reviews (PMR) addressing cost, schedule and performance; discussing progress from and issues arising since the last review and recommendations for the way ahead. [R1] ***[Project Management Review]***

f: CONTRACT STATUS REPORTING: The Contractor shall provide ongoing contract activity status to include planned versus actual task completion, outstanding issues and recommendations. The Contractor shall describe services provided, travel in support of the contract, and anticipated activity for the next reporting period. [Monthly Status Report]

g: Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

3.0 GOVERNMENT FURNISHED ITEMS:

a: GENERAL: The Government will supply LaRC on-site office space, network access, and telephone accessibility.

b: INFORMATION: The Government will provide copies of, or access to, all required directives, publications, products and documents as available. The Government will also provide necessary, available and reasonable access to functional personnel. All contact with government personnel outside of LaRC shall be coordinated through the Technical Monitor. The Government will coordinate joint meeting sessions between functional personnel from other

sites and Contractor personnel. The Government will provide the required facilities for these meeting sessions.

4.0 OTHER ESSENTIAL INFORMATION:

a: PLACE OF PERFORMANCE. All work in support of this PWS shall be performed primarily at the Langley Research Center, Hampton, VA.

b: TRAVEL. Extensive travel may be required in the execution of tasks on this order. Travel will be in accordance with the Joint Travel Regulations. Authorization to travel must be approved by the TPOC / PM. All travel shall be coordinated with site POCs, if applicable. While on a Government site, the Contractor shall conform to the site hours of operation.

5.0 Security Clearance, ITAR, OCI, and Other Special Handling Issues:

Information and material processed under this task order is unclassified, but is considered business sensitive. Contractor personnel working on this task order shall comply with local security policies and regulations.

6.0 PERIOD OF PERFORMANCE:

Planned start date: [TD1] 8 May 2008

Completion date: [R1] ~~31 December 2008~~
31 December 2009

7.0 NASA TASK MANAGEMENT:

TECHNICAL MONITOR:

NAME: Albert E. Motley III
M/S: 114
Phone: 757-864-1879

OTHER POC:

NAME: Noreen Smith
M/S: 114
Phone: 757-864-9500

TASK ORDER NUMBER: 069D3-NNL08AM17T Revision: 1 Change: 0 Date: November 3, 2008

Title: **System Development for Electron Beam Freeform Fabrication**

1. Purpose, Objective, or Background (Optional)

Electron beam freeform fabrication (EBF^3) is an emerging metal fabrication process using an electron beam to create a molten pool. Feedstock material, typically in wire form, is fed into the molten pool and the part is translated with respect to the beam to build up components in a layer-additive fashion. Due to the rapid attenuation of the electron beam in a gaseous environment, EBF^3 is typically performed at high vacuums ($5x10^{-5}$ Torr). The vacuum environment is clean, but selective vaporization of alloying elements occurs more readily in a vacuum.

Technical Direction 1 (4/29/08): Updates the initial task order start date to April 21, 2008 as issued by the CO on 4/21/08 (see [TD1] below, Section 6).

Revision 1 (11/03/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with added and updated requirements (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

This task is to provide engineering support for design, fabrication, implementation, and testing of modifications to the existing EBF^3 systems. This task will also evaluate mating the vacuum barrier system to different commercial and experimental electron beam gun designs to explore the best combination of electron beam source and vacuum system for maintaining appropriate processing parameters to sustain EBF^3.

2.1 (Requirement/subtask number one):

The Contractor shall support the development and implementation of a new vapor barrier system (VBS) design to enable maintaining a high vacuum in the cavity where the electron beam is generated, and pass it through to a system with partial gas pressures. Initial pressures are targeted to 5-10 Torr, similar to pressures on the Martian surface by providing:

a) Design and development of the VBS device. This includes shop support, testing of the vacuum barrier system at LaRC, and coordinating any modifications required to attain optimum performance of the device.
b) Coordinating with outside entities for the integration of the VBS with an electron gun and the required beam alignment.
c) Testing of the integrated VBS and the electron gun.
d) Demonstration of the ability of the integrated VBS-electron gun system to be used for free form fabrication.

*****Begin [R1] block additions with updates*****

The Contractor shall also support enhancement and integration of hardware to improve the wire feeder and process monitoring devices for establishing closed loop control on the EBF^3 system by providing:

a) Design and development of improved wire feeder that enables feeding of flat wire. This includes shop support, integration of new design features into existing EBF^3 hardware in building 1232A, and testing of the performance of the new system.
b) Design and integration of brackets for supporting and precisely positioning process monitoring detector hardware into the existing EBF^3 hardware. This includes evaluation of the hardware, design and fabrication of the integration brackets, and supporting testing of the process monitoring devices to assess the most effective method for developing into closed loop process control.

c) Continued improvement in the design of EBF^3 hardware for expanded functionality and improved performance. This includes design, shop support, integration, and assessment of the design improvements for the large-scale EBF^3 system in bulding 1232A and the prototype portable EBF^3 systems in building 1205.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

1) Integration and alignment of the process monitoring detector into EBF^3 system (11/30/08).

2) Complete testing of the process monitoring detector with EBF^3 system (1/15/09).

3) Integration and alignment of the VBS and an electron gun (1/31/09).

4) Complete testing of VBS integrated with the electron gun (2/15/09).

5) Demonstration of the ability of the VBS-electron gun to perform freeform fabrication (3/31/09).

6) Report detailing the VBS system and test results (4/30/09).

7) Redesigned wire feeder integrated and demonstrated with EBF^3 system (5/31/09).

8) Integrate efficient, lightweight design improvements for prototype EBF^3 system (12/31/09).

*****End [R1] block additions with updates*****

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: All required deliverables on time.

Exceeds: Either one or combination of the following:

a) Meets plus half or more of the deliverables ahead of schedule by one week or more.

b) Meets plus any of the deliverables requiring extraordinary work around (or other Contractor implemented actions) to meet the requirement and schedule.

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

A. Computer workstations

B. Vacuum chamber and support equipment

C. [R1>]***Large-scale electron beam freeform fabrication (EBF3) system, bldg. 1232A***

D. Prototype portable electron beam freeform fabrication (EBF3) systems, bldg. 1205[<R1]

4. Other Essential Information:

The Contractor shall participate in appropriate technical conferences/short courses to maintain cognizance of new approaches and to refresh skills, as needed, to support the requirements of this task order.

Travel will be required.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: [TD1]April 21, 2008 Completion date: [R1]~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Karen Taminger

M/S: 188A Phone: 757-864-3131

TASK ORDER NUMBER: 003C1-NNL08AM18T Revision: 3 Change: 0 Date: April 22 2009

Title: Physics Based Math Model of a LO2/Methane Propulsion System

1. Purpose, Objective, or Background (Optional)

NASA Exploration Technology Development Program (ETDP) Propulsion and Cryogenic Advanced Development (PCAD) project is performing technology and advanced development of LO2/methane to evaluate for use on a lunar lander ascent stage. A high fidelity math model of an ascent type propulsion system is required to support the design and test of this new technology. The purpose of this effort is to build a physics based math model of a LO2/methane system.

Technical Direction 1 (7/25/08): Updates the initial task order start date to July 14, 2008 as issued by the CO on 7/11/08 (see [TD1] below, Section 6).

Revision 1 (8/18/08): Extends the period of performance 3 months to February 18, 2009 to accommodate delays in initial startup (see [R2] below).

Revision 2 (1/7/09): Extends the period of performance another 3+ months to May 30, 2009 to accommodate some NASA issues and changes the Technical Monitor (see [R2] below). Note: Informal coordination indicates that the effect on the subcontract is a no cost extension.

Revision 3 (4/22/09): Extends the period of performance another 2 months to July 31, 2009 to realign product delivery with the NASA schedule and make up time for some unexpected delays (see [R3] below, Section 6). Note: Informal coordination still indicates that the effect on the subcontract is a no cost extension.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Build Physic Based Model:

The Contractor shall build a physics based math model of a LO2/methane pressure-fed propulsion system. The model shall incorporate the 1-D thermal, thermodynamic, and fluid physics of the propulsion system and the environment. The system consists of a separate cold Ghe (gaseous helium) pressurization systems for oxidizer and fuel, 4 propellant tanks (2 oxidizer and 2 fuel), cryogenic feedlines with integral thermodynamic vent line that feeds propellant to the 4 RCS (Reaction Control System) quads and main engine , 16 RCS engines, and a main engine. The engines shall be modeled using chamber pressure (Pc), exhaust gas characteristic velocity (cstar), propellant flow rate (m_dot), mixture ratio (MR) relationships or better. A front end/input file/screen that would allow the system size (tanks, layers multi-layer insulation (MLI), thrusts, dimensions, etc) shall be provided. Model internal interfaces shall be designed to allow exporting engineering data in formats that are compatible with system cost and schedule estimating tools.

2.2 Run Physic Based Model:

The model shall be run for different mission durations, engine duty cycles, ascent stage or service module type, and for different external environments.

2.1.1 Milestones (Optional):

Model review Date

Results

2.1.2 Deliverables and Schedule (Required):

The model shall be completed in less than 6 months from ATP, with appropriate Contractor-provided milestones and review dates. The deliverable will be the model and a final report - at task completion.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: All reviews, deliverables, and milestones on time.

Exceeds: Meets with 50% of items two weeks ahead of schedule.

2.3 Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.3.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.3.2 Required date: Ongoing.

2.3.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

NASA will supply drawings and schematics for the propulsion system. NASA will provide design details and test data on the cryogenic feedsystem and RCS engine performance as required.

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

The Contractor shall have a non-disclosure agreement. The Contractor shall meet ITAR requirements.

6. Period of Performance:

Planned start date: [TD1] 7/14/08

Completion date: [R1] ~~11/15/08~~ [R2] ~~2/18/09~~ [R3] ~~5/30/09~~ ***7/31/09***

7. NASA Task Management:

Technical Monitor (Required): [R2] **Brian S. Lusby**

M/S: NASA-JSC-ep4 Phone: 281-483-8386

Other POC (Optional): Pam Throckmorton

M/S: 105 Phone: 757-864-4403

TASK ORDER NUMBER: 070D3-NNL08AM19T Revision: 2 Change: 0 Date: March 24, 2009

Title: Transonic Dynamics Tunnel (TDT) Testing and Analysis Support for Ares I-X

1. Purpose, Objective, or Background (Optional)

The goal of this task order is to provide support to the Ares Aeroelasticity Test & Analysis Team in its role of leading the testing and analysis for the aeroelastic assessment of the Ares launch vehicles.

Technical Direction 1 (6/6/08): Updates the initial task order start date to June 5, 2008 as issued by the CO on 6/5/08 (see [TD1] below, Section 6).

Revision 1 (12/5/08): Extends the period of performance 9 months to September 30, 2009 at no anticipated additional cost with two primary areas identified/updated for continued work, and changes the Technical Monitor (see [R1] below).

Technical Direction 2 (1/9/09): Reverts Technical Monitor duties to Stan Cole (see [TD2] Section 7, below).

Revision 2 (3/24/09): Adds clarifications to some requirements (see [R2] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one): Analyses in Support of Ares I-X Ground Wind Loads TDT Wind-Tunnel Test (7/18 – 8/12)

The Contractor shall perform NASTRAN static and dynamic analysis (normal modes and response) for the Ares I-X GWL model, update 'design' FEM with 'as-built' properties and modal characteristics; perform design optimization to correlate modal characteristics with ground vibration test data.

The Contractor shall support data reduction and reporting of Ares I-X GWL data.

2.1.1 Milestones

Document & report analysis and deliver results; 6/1 – 10/1

Document & report analysis and deliver results; 7/18 – 12/1

2.1.2 Deliverables and Schedule

Document & report analysis and deliver results; 6/1 – 10/1

Document & report analysis and deliver results; 7/18 – 12/1

2.1.3 Performance Metrics/Standards

Meets: All deliverables on time and complete.

Exceeds: Deliverables ahead of schedule by two weeks or more with use of insightful approaches.

2.2 (Requirement/subtask number two): Testing in Support of Ares I-X Ground Wind Loads TDT Wind-Tunnel Test

The Contractor shall perform balance calibration and static load testing of the Ares I-X GWL model assembly, perform ground vibration testing of the Ares I-X GWL model assembly, and support preparation for testing and the testing itself of the Ares I-X GWL model in the TDT.

2.2.1 Milestones

Document & report calibration and static load test results and deliver data, 7/1 – 7/17

Document & report GVT test results and deliver data; 7/1 – 7/17, - 8/12

Ares I-X GWL TDT test preparation and test; 7/1 – 8/12

2.2.2 Deliverables and Schedule

Document & report calibration and static load test results and deliver data, 7/1 – 7/17

Document & report GVT test results and deliver data; 7/1 – 7/17, - 8/12

Ares I-X GWL TDT test preparation and test; 7/1 – 8/12

2.2.3 Performance Metrics/Standards
Meets: All deliverables on time and complete.
Exceeds: Deliverables ahead of schedule by two weeks or more with use of insightful approaches.

2.3 (Requirement/subtask number three): Instrumentation Support of Ares I-X Ground Wind Loads TDT Wind-Tunnel Test
The Contractor shall support instrumentation installation, functional checkout, calibration, and end-to-end testing of strain-gauge balance, accelerometers, pressure transducers, pressure manifolds and flexible tubing, and instrumentation cables of the Ares I-X GWL wind-tunnel model and test in the TDT.

2.3.1 Milestones
Document installation, checkout, calibration, and end-to-end testing activities and report data; 7/1 – 8/12

2.3.2 Deliverables and Schedule
Document installation, checkout, calibration, and end-to-end testing activities and report data; 7/1 – 8/12

2.3.3 Performance Metrics/Standards
Meets: All deliverables on time and complete.
Exceeds: Deliverables ahead of schedule by two weeks or more with use of insightful approaches.

2.4 (Requirement/subtask number four): Analyses in Support of Ares I Rigid Buffet Model TDT Wind-Tunnel Test (8/13 – 9/12)
The Contractor shall perform buffet response analysis for the Ares I Crew Launch Vehicle using NASTRAN/Craig-Bampton models and wind-tunnel derived buffet forcing functions; support data reduction and reporting of Ares I RBM data; and perform MATLAB signal processing analysis of high-frequency fluctuating pressure data. R1>The Contractor shall perform Finite Element Analysis of the Ares I vehicle response to Rigid Buffet Model buffet forcing functions.<R1

2.4.1 Milestones
Document buffet response analysis and report results; 9/12 – 12/1
Document data reduction and analysis and report results 6/1 – 11/1

2.4.2 Deliverables and Schedule
Document buffet response analysis and report results; 9/12 – 12/1
Document data reduction and analysis and report results 6/1 – 11/1
R1>Document Finite Element Analysis (FEA) R2>***methodology and results, including process of using buffet forcing functions in FEA.***<R2 9/30/09<R1

2.4.3 Performance Metrics/Standards
Meets: All deliverables on time and complete.
Exceeds: Deliverables ahead of schedule by two weeks or more with use of insightful approaches.

2.5 (Requirement/subtask number five): Testing in Support of Ares I Rigid Buffet Model TDT Wind-Tunnel Test (8/13 – 9/12)
The Contractor shall lead acceptance testing of approximately 300 Kulite pressure transducers to include

static pressure and dynamic fluctuating pressure response characteristics (frequency response functions); lead the effort to set-up, install, measure, R1> and report TDT wall fluctuating pressures for the Ares I RBM test; <R1 and support Ares I RBM testing at the TDT. R2> ***In reporting the TDT wall fluctuating pressures, the Contractor shall address reasonable issues that come out of the Technical Quality Review process for the Ares I RBM.*** <R2

2.5.1 Milestones
Document acceptance testing and report results; 6/1 – 8/13
Document data from fluctuating pressure portion of test and report results 6/1 – 11/1
Support Ares I RBM testing at the TDT; 7/17 – 9/12

2.5.2 Deliverables and Schedule
Document acceptance testing and report results; 6/1 – 8/13
Document data from fluctuating pressure portion of test and report results 6/1 – R1 ~~11/1~~ R2 ***5/31/09***.
Support Ares I RBM testing at the TDT; 7/17 – 9/12

2.5.3 Performance Metrics/Standards
Meets: All deliverables on time and complete.
Exceeds: Deliverables ahead of schedule by two weeks or more with use of insightful approaches.

2.6 (Requirement/subtask number six): Instrumentation Support of Ares I Rigid Buffet Model TDT Wind-Tunnel Test (8/13 – 9/12)
The Contractor shall support instrumentation installation, functional checkout, calibration, and end-to-end testing of strain-gauge balance, accelerometers, Q-flexes pressure transducers, pressure manifolds and flexible tubing, and instrumentation cables of the Ares I RBM wind-tunnel model and test in the TDT.

2.6.1 Milestones
Document installation, checkout, calibration, and end-to-end testing activities and report data; 7/17 – 9/12

2.6.2 Deliverables and Schedule
Document installation, checkout, calibration, and end-to-end testing activities and report data; 7/17 – 9/12

2.6.3 Performance Metrics/Standards
Meets: All deliverables on time and complete.
Exceeds: Deliverables ahead of schedule by two weeks or more with use of insightful approaches.

2.n Sub-Task n - Working Environment Safety and Organization (Required)
The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:
Exceeds: No cited findings or reportable incidents in six-month award fee period.
Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):
Wind-tunnel data associated with the Ares Project is considered ITAR. The Contractor shall comply with the ITAR requirements.

6. Period of Performance:

Planned start date: [TD1] June 5, 2008 Completion date: [R1] ~~December 31, 2008~~ September 30, 2009

7. NASA Task Management:

Technical Monitor (Required): [TD2] Stanley R. Cole
M/S: 340 Phone: 757-864-1267
Other POC (Optional): Boyd Perry, III
M/S: 340 Phone: 757-864-2840

TASK ORDER NUMBER: 011E4-NNL08AM20T Revision: 0 Change: 0 Date: May 14, 2008

Title: Green Team Systems Analysis

1. Purpose, Objective, or Background (Optional)

This task order describes support for an advanced planning team that is tasked with preparing NASA Langley for a new kind of challenge - a challenge to solve an international crisis. NASA may be called upon, soon, to apply its unique knowledge and technologies to address, head on, the environmental changes that appear to be happening. Many of the nation's top scientists are concerned that these changes could threaten the very existence of life on this planet. This work has the potential to become a unifying and audacious goal that can inspire laymen and technologists for decades from now in a manner similar to the Apollo era. The following activity objectives are envisioned:

- analyze the problem space and understand it,
- catalog all that Langley can bring to solving those problems,
- determine which are the most promising solution strategies, and
- develop an advocacy package around those strategies and
- answering the questions, "Why NASA?" and "Why now?" and "How much?"

The overall objective is to be done by the end of the calendar year, but a working advocacy package should be ready by the end of the Fiscal year.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one): The problem space is broken into stopping the human influences and repairing the environment. Further subdivision yields a total of nine areas.

- Energy generation,
- Energy transmission
- Energy storage
- Energy conservation
- Damaging emissions related to power generation,
- Reversing dangerous trends in the atmosphere,
- Reversing dangerous trends in the oceans,
- Reversing dangerous trends in our soil, and
- Reversing dangerous trends in freshwater sources.

There will be one brainstorming and review session each week for the 9 areas on Wednesdays at 1pm in the Navigation Center B1212. Subsequent actions include:
Generating integrated solutions as a broad team and having the systems analyst estimate the impact and the likelihood of success of each idea. NASA will also need to estimate the R&D cost of each concept and include a first order development timeline/schedule. All of that will feed into the advocacy package to be delivered to LaRC senior staff (CLC).

The Contractor shall perform the following requirements:
1) Attend weekly green team symposia and develop/or gather notes from the Navigation Center staff to understand and catalog the ideas generated. It is expected that the Contractor will actively participate to

understand and clarify technologies and/or operational concepts in addition to creatively adding to the potentials list of the team.

2) Create (a) generalized future scenario(s) suitable for analyzing the technologies and/or operational concepts. A scenario shall provide a baseline of detail that issues forth in a straightforward method for ranking the notional impacts, technical development risks and barriers and development costs on a notional or first principles level. Examples include: the past Aeronautics Systems Analysis Branch (ASAB) contributions to the Joint Planning and Development Office (JPDO) futures working group and/or others that ASAB can provide upon request of the Contractor.

3) Work with the Green Team and other LaRC center subject matter experts to develop first order R&D cost estimates and development timelines.

The Contractor should also address the key enabling technologies and/or elements of the scenario that involve externalities which either negate the potential impact or are necessary conditions for the technology/operational change R&D idea moving forward. Example: Develop next generation aviation system transport that utilizes 100% hydrogen fuel cell power technology. This idea would require someone to develop high specific power hydrogen fuel cell power technologies (when and how high specific power)

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

1. Notes and pre-decisional analyses of the output for each of the nine focus areas of the green team. These may be posted onto a shared document server and should be in electronic form to facilitate posting. The *schedule of delivery is flexible, but at a minimum shall be at the end of each calendar month* for the duration of the study period (currently this is 1/15/2009).

2. A working (first draft) future scenario that enables the activities overall 1-3 by *July 18, 2008*. This short text file shall be made available in electronic format to facilitate posting to the green team shared document system.

3. A midterm assessment of the technologies/strategies/operational concepts prepared with the input of the Green Team and covering:

-relative impact on the global objective in the context of the future scenario
-feasibility or potential of LaRC to contribute meaningfully towards the research
-assessment of other technical development risk overall
-a list of global assumptions and/or constraints used to perform the analysis
-estimates (rough or first order) of the R&D costs and schedule for each feasible technology/strategy.

Due *August 8, 2008* to team.

4. Assist the team in revisions and additions to deliverables 1 thru 3 to include as content into the initial green team decision analysis package to senior staff by *September 30, 2008*.

5. Ongoing refinements are anticipated. These refinements could include second look with possibly greater fidelity and an overall revision of the deliverables 1, 2 and 3 with a completion date on or before *January 15, 2009*.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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 organization and clarity of results.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: None at this time.

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: June 16, 2008 Completion date: January 15, 2009

7. NASA Task Management:

Technical Monitor (Required): William M. Kimmel

M/S: 442 Phone: 757-864-7136

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 071D3-NNL08AM21T Revision: 1 Change: 0 Date: February 27, 2009

Title: Continued Design and Development of Test Hardware for Airframe Noise Reduction

1. Purpose, Objective, or Background (Optional) (Follow-on to TEAMS task order 051D3-NNL07AM81T)

Provide engineering design and development of test hardware in support of Langley's Airframe Noise Reduction objectives of the Subsonic Fixed Wing Project. The specific objectives of the work to be performed under the present task are to leverage the findings of TEAMS task order 051D3-NNL07AM81T to design, develop, and perform concept evaluation of three low-noise leading edge slat structural concepts.

Technical Direction 1 (7/14/08): Updates the initial task order start date to July 09, 2008 as issued by the CO on 7/8/08 (see [TD1] below, Section 6).

Revision 1 (2/27/09): Extends the period of performance 9 months to December 31, 2009 in continuation of NASA's support and updates the schedule accordingly (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall review the status of concept-three development from TEAMS task order 051D3-NNL07AM81T. The Contractor shall review recent developments in the state of the art for slat cove filler contours and assess the impact on the concept-three design. The Contractor shall finalize the concept-three design and develop final drawings. The Contractor shall procure superelastic shape memory alloy spring material as required for the finalized design. The Contractor shall oversee the fabrication of components required to demonstrate the new design. The Contractor shall support the evaluation of the new design under representative load on the bench top.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

- Final design and drawings for concept three ([R1] ~~08/31/2008~~ ***05/31/2009***).
- Demonstration and performance evaluation of prototype concept-three structure ([R1] ~~11/01/2008~~ ***12/31/2009***).

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: One or more final designs, completed drawings, and hardware delivery for concept three.

Exceeds: Items under "Meets" plus successful demonstration of the prototype structure under

representative static load on the bench top.

2.2 (Requirement/subtask number two):

The Contractor shall develop a concept-four design based upon the idea of closing the gap between the deployed slat and the main wing element via an extensible structure. The extensible structure must completely fill the gap at all times, must sustain simulated aerodynamic loads representative of the application, and must include measures to allow it to be defeated in an emergency event requiring maximum coefficient of lift. The Contractor shall develop final drawings for the concept-four design. The Contractor shall oversee the fabrication of components required to demonstrate the concept-four design. The Contractor shall support the evaluation of the new design under representative load on the bench top.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

- Initial concept-four design ([R1]~~09/30/2008~~ ***03/31/2009***).
- Final design and drawings for concept four ([R1]~~12/31/2008~~ ***05/31/2009***).
- Demonstration and performance evaluation of prototype concept-four structure ([R1]~~03/01/2009~~ ***09/30/2009***).

2.2.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: One or more final designs, completed drawings, and hardware delivery for concept four.

Exceeds: Items under "Meets" plus successful demonstration of the prototype structure under representative static load on the bench top.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: Bench-top model, first generation of concept one, first generation of concept two, single span-wise station test rig, and materials for fabrication of final design(s) (excluding superelastic shape memory alloy).

4. Other Essential Information: Designs resulting from this work are considered proprietary.

5. Security Clearance: None

6. Period of Performance:

Planned start date: TD1 07/09/2008 Completion date: R1 ~~03/31/2009~~ ***12/31/2009***

7. NASA Task Management:

Technical Monitor (Required): Travis L. Turner

M/S: 463 Phone: 757-864-3598

Other POC (Optional):

M/S: Phone:

1. Purpose, Objective, or Background (Optional)

Background

The Mars Science Laboratory (MSL), scheduled for launch in 2009, will incorporate pressure measurement instrumentation in the heat shield to measure the surface pressure response during the Entry, Descent, and Landing (EDL) phase in the Martian atmosphere. The MSL Entry, Descent, and Landing Instrumentation (MEDLI) / Mars Entry Atmosphere Data System (MEADS) program will incorporate pressure ports through the external heat shield connected to pressure transducers internal to the spacecraft to measure the pressure response on the surface of the heat shield.

In October 2007, the Thermal Protection System (TPS) heat shield for MSL was changed from Super Lightweight Ablator (SLA) -561V material to Phenolic Impregnated Carbon Ablator (PICA) material. The MEDLI/MEADS program performed a series of stagnation test in the Boeing Large Core Arc Tunnel (LCAT) in March 2007. In March/April of CY08 pressure port performance was evaluated for the new MSL heat shield material, PICA, under simulated MSL entry aeroheating conditions in task NNL08AM10T, contract NNL07AA00B. In addition to stagnation testing, a surface shear stress testing program will be performed to demonstrate acceptable pressure port operation in the PICA material under shearing conditions. Specifically, the interaction of the pressure port at the surface interface with the PICA material will be evaluated under shearing conditions to demonstrate acceptable performance at maximum (plus three-sigma) predicted flight entry condition. In addition, surface pressure will be measured to demonstrate acceptable pressure measurement performance of the pressure port during shearing conditions.

The test condition that is required to properly simulate the predicted maximum shear force condition that the pressure ports will experience in flight is rather unique and has not been demonstrated in any of the Nation's arc jet facilities. Because of the pressure port locations on the MSL heat shield there is a unique set of conditions in flight (surface pressure, heat flux, and shear stress) that result in a relatively high surface pressure, relatively low heat flux, and low surface shear. The Boeing LCAT facility has been identified as the only facility that has the potential of closely matching all three of these conditions simultaneously. However, the nozzles that have been identified that can potentially meet these requirements have not been calibrated to this unique set of conditions.

Two nozzles have been identified at the LCAT facility for calibration testing to assess their performance and suitability for meeting the pressure port shear test requirements. The 4-inch Axisymmetric (4"-Axi) nozzle is the primary nozzle that appears to offer the best potential of meeting all of the condition requirements and the Semi-Elliptic Nozzle (SEN) Throat Section is considered to be a back-up nozzle that has slightly lower potential of satisfactorily meeting all of the MEADS requirements.

One approach is to configure the facility and fully calibrate the 4"-Axi nozzle and in parallel design and fabricate hardware for potential calibration of the SEN nozzle. If the 4"-Axi nozzle calibration demonstrates acceptable performance then the SEN nozzle calibration effort will be terminated and the SEN will not be calibrated. However, if the 4"-Axi nozzle does not satisfactorily meet all of the requirements, and analysis and evaluation indicate that the SEN nozzle has the potential to improve over some of the 4"-Axi nozzle performance deficiencies, then the SEN nozzle will be calibrated. If

both nozzles are calibrated, then a down-select will be made following the calibration efforts with the intent to select the nozzle that offers the best performance for the pressure port shear testing objectives.

Test Objectives

Primary - Calibrate the Boeing LCAT 4"-Axi nozzle to determine if it meets shear testing requirements for evaluation/demonstration of the pressure ports.

Technical Direction 1 (7/16/08): Updates the initial task order start date to July 9, 2008 as issued by the CO on 7/9/08 (see [TD1] below, Section 6).

2. Description of the Work to be Performed:

The Contractor shall perform a shear calibration test using wedge model configurations. The arc heater configuration and performance shall be adjusted and modified as needed in a best effort to meet the desired Test Conditions as specified below.

2.1 (Requirement/subtask number one):

Design and fabrication of heat flux and pressure calibration plates, modification of model holders as required for calibration testing, and calibration of the 4"- axisymmetric nozzle. Calibration test duration of the 4"-axisymmetric nozzle is estimated to be five (5) work days.

The nozzle calibration effort shall consist of the following models exposed to the test flow to determine the test conditions:

1) A calorimeter plate to measure surface heat flux with sufficient distribution of heat flux gages on the surface to adequately map the surface heating profile (a possible design is shown below).

2) A pressure plate to measure the surface pressure with sufficient distribution of pressure taps to adequately map the surface pressure profile (a possible design is shown below).

3) A Teflon plate to determine flow uniformity and surface heating. The nominal Teflon density shall be 135.0 lbm/ft^3.

4) Thermal Protection Material (TPS) to evaluate the response of a TPS material and to evaluate flow uniformity.

The Contractor shall provide items 1, 2, and 3. NASA will provide item 4.

The Contractor shall perform various calibration runs as needed, exposing the calorimeter plate and the pressure plate (Items 1 & 2 above) to the flow to evaluate the flow conditions, until it has been determined that the closest match of pressure and heat flux have been achieved. When the Contractor and NASA (Langley Arc Jet Test Lead) have jointly determined that no further refinement of the arc heater conditions will improve the test simulation or the required surface pressure and heat flux have been met, then a full calibration effort of this condition will be performed.

The full calibration effort shall consist of exposing items 1 through 4 to the test flow to obtain calibration data. The duration of exposure of items 3 and 4 will be determined by the Langley Arc Jet Test Lead to simulate the predicted flight heat load and is expected to be in the range of 30 to 40 seconds.

The total time to complete the calibration effort on the 4" axisymmetric nozzle (once all plates have been manufactured) shall not exceed 1 week (5 business days.)

Test Conditions

Presently there are two design trajectories for the MSL program, 08-TPS-02 and 08-TPS-01a. Maximum (plus three-sigma) conditions will be used. The -02 trajectory provides the highest conditions for surface pressure, heat flux, and shear while the -01a trajectory has the highest heat load.

The required test conditions are:

Surface Pressure = 0.25 atm
Cold Wall Heat Flux = 118 W/cm^2
Surface Shear Stress = 152 Pa
Heat Load = 3885 J/cm^2

Test Articles

The Contractor shall provide the calorimeter plate, pressure plate, and Teflon calibration samples. The calorimeter and pressure plates shall have sufficient heat flux gages and pressure taps to map the surface conditions. The pressure taps and heat flux gages shall be installed in identical locations on the plates. A possible design is presented in Figure 1, but the Contractor shall submit a design to NASA (Langley Arc Jet Test Lead) for the calorimeter and pressure plates for review and approval prior to fabrication.

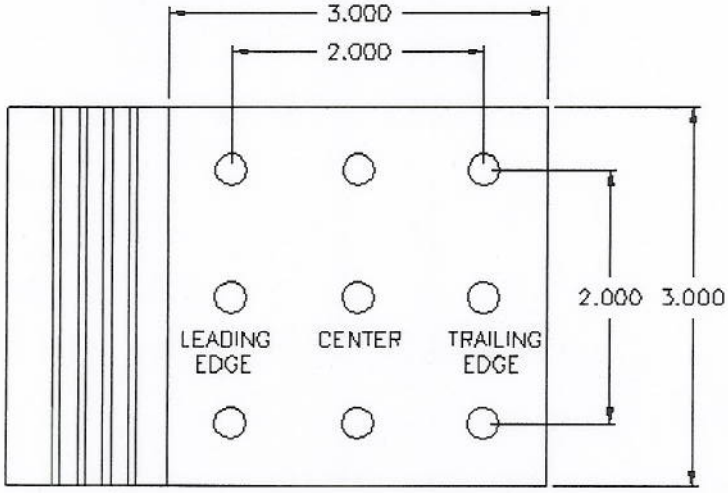


Figure 1. Possible distribution of calorimeter and pressure taps on 3" x 3" calibration plates.

Specimen Holders

The Contractor shall provide all test holders and associated equipment to perform the calibration.

Specimen Pre-Test Preparation

1. Each specimen shall be inspected on receipt for any shipping damage. Any damage shall be reported to the Langley Arc Jet Test Lead and documented.
2. Pre-test photographs shall be taken of each specimen to thoroughly document the pre-test condition.
3. Pre-test weights of the samples shall be made and recorded.
4. Each test specimen shall be kept in a controlled storage area until tested. Positive identification of each test specimen shall be maintained at all times.

Specimen Post-Test Disposition

1. The Contractor shall examine the specimen on the sting in the specimen holder after exposure and cool-down.
2. Post-test photographs shall be taken of each specimen inside the chamber if data will be lost from movement of the model. Additionally, photos shall be taken of the model after removal from the test facility.
3. Post-test weights of the samples shall be made and recorded.
4. Post-test recession measurements shall be made at nine different locations on the model surface as determined by the Langley Arc Jet Test Lead.
5. Upon completion of testing and post-test documentation, selected samples as determined by the Langley arc jet test lead shall be appropriately packaged, labeled, and express shipped to NASA-Langley for further examination.

Langley Shipping Address:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

Test Data

1.0 Facility operating conditions including enthalpy, pressure, mass flow rate, arc current, arc voltage, etc, shall also be provided to the Langley Arc Jet Test Lead with the final data package or sooner at the discretion of the Contractor.

2.0 Test data shall also be provided electronically to designated recipients (see below, **Test Documentation and Reporting**).

Photographic Coverage

The Contractor shall take close-up digital photographs (in addition to overall views discussed above) of any damage or change as the post-test condition of any specimen warrants. Each photograph shall be identified using photo cards and contain the following minimum information:

1. Test Title
2. Test Date
3. Test Number
4. Part Identification Number
5. Pretest/Test/Post-test Chronology
6. Description of View (front, back, side, etc.)

The Contractor shall provide one set of preliminary photographs to the Langley Test Lead upon request. Photographs providing required information shall be included in the Test Report. One set of the archived photographs shall be provided to the Langley Test Lead in the final data delivery.

Video Coverage

The Contractor shall video record the model face and side views during the tests to verify model performance. Copies of the test video shall be delivered to the Langley Arc Jet Test Lead in the final data delivery.

2.1.1 Milestones (Optional): No specific milestones pertain to this work. The test matrix is expected to be completed within 2 weeks (10 business days).

2.1.2 Deliverables and Schedule (Required):

Drawings

The Contractor shall deliver drawing for calorimeter plate.

The Contractor shall deliver drawing for pressure plate.

Test Documentation and Reporting

Data may be e-mailed or shipped by mail. In addition, the Contractor shall deliver video and photos (pre and post-test) by e-mail or mail as soon as practical (the same day) following each test to the designated people below:

Name	e-mail address
Walt Bruce	Walter.E.Bruce@ nasa.gov

Kaitlin Liles Kaitlin.A.K.Liles@nasa.gov

Following completion of the test program, the Contractor shall deliver all data and documentation to the Langley Arc Jet Test Lead (including copies of any reports written). The following documentation shall be prepared in a report containing:

1. Pre and post-test weights of each test sample
2. Pre and post-test photographs of each test sample
3. Plots from test runs of temperature and pressure
4. Facility operating conditions (enthalpy, pressure, arc current, arc voltage, mass flow rate, etc.) at a minimum for each test condition. The preferred format is a tabulated set of data in digital format, for each parameter versus time.

The Contractor shall deliver all test data to the Langley Arc Jet Test Lead as soon as possible, but not later than two weeks after the conclusion of the test. All test models shall be shipped to the Langley Arc Jet Test Lead no later than one week after the conclusion of the test.

Return Shipping Addresses

Ship post-test samples, complete report package and all data to:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Twelve (12) test runs, per provided test matrix, successfully completed (conditions met to NASA satisfaction, no facility anomalies)

Exceeds: Greater than 12 test runs successfully performed within the test window (conditions met to NASA satisfaction, no facility anomalies)

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: NASA-Langley will provide the TPS samples. All of the TPS test articles will be preassembled and shipped to Boeing-St. Louis at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test. Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request.

4. Other Essential Information:

Contractor personnel shall participate in a Test Readiness Review (TRR) via telecon within 7 business days before the scheduled test start. Telecon arrangements will be made by the Langley Arc Jet Test Lead, in coordination with the Contractor personnel.

Test Notification and Attendance

The Contractor shall provide the Langley Arc Jet Test Lead sufficient notice in advance of a test to permit attendance at the test. The Langley Arc Jet Test Lead shall be notified of any changes to the test schedule. The Contractor shall accommodate a representative from Lockheed Martin Space Systems Company to witness the testing in its entirety.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): No security clearances or other special provisions are required, other than the sample handling requirements specified above.

6. Period of Performance:

Planned start date: [TD1] ***July 9, 2008*** Completion date: July 31, 2008

7. NASA Task Management:

Technical Monitor (Required): **Walter Bruce**
M/S: 431 Phone: 757-864-7024

Other POC (Optional): **Michelle Munk**
M/S: 494 Phone: 757-864-2314

1. Purpose, Objective, or Background (Optional)

Background

The Mars Science Laboratory (MSL), scheduled for launch in 2009, will incorporate pressure measurement instrumentation in the heat shield to measure the surface pressure response during the Entry, Descent, and Landing (EDL) phase in the Martian atmosphere. The MSL Entry, Descent, and Landing Instrumentation (MEDLI) / Mars Entry Atmosphere Data System (MEADS) program will incorporate pressure ports through the external heat shield connected to pressure transducers internal to the spacecraft to measure the pressure response on the surface of the heat shield.

In October 2007, the Thermal Protection System (TPS) heat shield for MSL was changed from Super Lightweight Ablator (SLA) -561V material to Phenolic Impregnated Carbon Ablator (PICA) material. The MEDLI/MEADS program performed a series of stagnation test in the Boeing Large Core Arc Tunnel (LCAT) in March 2007. In March/April of CY08 pressure port performance was evaluated for the new MSL heat shield material, PICA, under simulated MSL entry aeroheating conditions in task NNL08AM10T, contract NNL07AA00B. In addition to stagnation testing, a surface shear stress testing program will be performed to demonstrate acceptable pressure port operation in the PICA material under shearing conditions. Specifically, the interaction of the pressure port at the surface interface with the PICA material will be evaluated under shearing conditions to demonstrate acceptable performance at maximum (plus three-sigma) predicted flight entry conditions. In addition, surface pressure will be measured to demonstrate acceptable pressure measurement performance of the pressure port during shearing conditions.

Both stagnation and shear development test series are required to finalize the flight concept for the pressure port configuration prior to flight build. These test series build on previous test and calibration results from the LCAT facility.

Test Objectives

Subtask One: To evaluate pressure port performance in the MSL heat shield material, PICA, under simulated MSL entry stagnation aeroheating conditions. Specifically, the desired outcome from this test is to down select to either a 0.050-inch or 0.070-inch diameter pressure port and determine if an oxidation-reduction sleeve is required.

Subtask Two: To evaluate pressure port performance in the MSL heat shield material, PICA, under simulated MSL entry aeroheating surface shear stress conditions. To simulate the proper test conditions the contractor shall use a wedge type test technique to provide the desired surface heat flux, pressure, and shear. Specifically, the desired outcome from this test is to demonstrate that either a 0.050-inch or 0.070-inch diameter pressure port will not have adverse effects on the MSL heatshield integrity, and secondarily, to demonstrate acceptable pressure measurement through the MSL PICA heatshield in a shearing environment.

Technical Direction 1 (8/6/08): Updates the initial task order start date to August 5, 2008 as issued by the CO on 8/5/08 (see [TD1] below, Section 6).

2. Description of the Work to be Performed:

The Contractor shall perform stagnation arcjet (Subtask One) and shear arcjet (Subtask Two) tests. The arc

heater configuration and performance shall be adjusted and modified as needed in a best effort to meet the desired Test Conditions as specified below.

2.1 (Requirement/Subtask One):

The Contractor shall perform stagnation tests to demonstrate the proof of concept pressure measurements and to evaluate the pressure port interface with the external surface of the heat shield. Details of the model configurations are given in Table 1. Twenty of the models will have two active pressure measurements and two additional dead-headed pressure ports. Each of the four pressure ports (two active-pressure and two dead-headed) per model will have a single thermocouple measurement for a total of four thermocouple measurements per model. Five of the models will have four dead-headed pressure ports with a single thermocouple per hole for a total of four thermocouples per model. In addition, there will be five witness PICA models with no pressure ports and a single bond-line thermocouple.

A total of three models plus a calibration probe shall be run per test. The contractor shall conduct a total of ten (10) test runs to evaluate these parameters. In addition, the contractor will perform a calibration run prior to each unique test condition. Two models of the same geometry as the pressure models, fabricated from Teflon, will be included on each of the calibration runs. The Teflon models do not have any instrumentation.

Boeing shall conduct a total of ten (10) stagnation test runs to evaluate pressure port diameters under relevant heating conditions. In addition, Boeing shall conduct calibration runs to verify facility test conditions prior to testing at each condition (minimum of three calibration runs).

Test Conditions for Subtask One

The various test conditions required to meet the stagnation test objectives are presented in Table 1. Boeing shall select the appropriate nozzle size and facility configuration to match these stagnation conditions as close as possible. Boeing shall receive the Langley Arc Jet Test Lead's concurrence on the acceptable test conditions for each run, based on calibrations. The heat flux and stagnation pressure shall be held at a constant value for the duration of the run or until the Langley Arc Jet Test Lead requests that the model be removed from the flow if before the end of the specified run duration. The Boeing LCAT test director may also terminate the test or remove the model from the flow for facility safety concerns.

A calibration run shall be performed prior to each run measuring the Pitot pressure and stagnation heat flux to verify appropriate test conditions. Boeing shall use the Boeing-fabricated 3.5-inch diameter slug calorimeter and the 3.5-inch Ames calorimeter on each calibration run to determine the flow-field conditions. In addition, two 3.5-inch Teflon calibration models, provided by Langley, shall be tested on each calibration run. If the conditions are within a predetermined tolerance band (tolerance to be determined) the test models will be installed and the test run will be performed. If the test conditions are not acceptable, Boeing shall attempt to adjust the conditions to meet the test requirements prior to proceeding to the test run.

The Langley Arc Jet Test Lead may request a test matrix change or model change with the understanding that it may impact schedule. The LCAT Test Engineer will be notified 24-hours in

advance of any potential changes if possible.

NASA Run Number	Test Condition	Target Test Conditions: Hot wall Heat Flux (W/cm^2)	Cold Wall Heat Flux (W/cm^2)	Stagnation Pressure (atm)	Test Duration (sec)	Total Energy Load (J/cm^2)	Test Models, Sting Arm Position: 1	3	4	5	Comment
Cal-1	1	55	87	0.38	40	2200	A	C-1	B	C-2	P1/P2 , Highest Pressure, Lowest q-dot
1	1	55	87	0.38	40	2200	A	E-1	F-1	D-1	P1/P2 , Highest Pressure, Lowest q-dot
2	1	55	87	0.38	40	2200	A	F-2	E-2	I-1	P1/P2 , Highest Pressure, Lowest q-dot
3	1	55	87	0.38	40	2200	A	G-1	H-1	D-3	P1/P2 , Highest Pressure, Lowest q-dot
4	1	55	87	0.38	40	2200	A	H-2	G-2	I-2	P1/P2 , Highest Pressure, Lowest q-dot
Cal-2	2	130	173	0.32	30	3900	A	C-3	B	C-4	P4/P5 Composite Condition
5	2	130	173	0.32	30	3900	A	E-3	F-3	D-5	P4/P5 Composite Condition
6	2	130	173	0.32	30	3900	A	F-4	E-4	I-3	P4/P5 Composite Condition
7	2	130	173	0.32	30	3900	A	G-3	H-3	D-7	P4/P5 Composite Condition
8	2	130	173	0.32	30	3900	A	H-4	G-4	I-4	P4/P5 Composite Condition
Cal-3	3	80	126	0.36	38	3040	A	C-5	B	C-6	P3
9	3	80	126	0.36	38	3040	A	E-5	F-5	D-9	P3
10	3	80	126	0.36	38	3040	A	G-5	H-5	I-5	P3

Model Name	Stagnation Model Description: Type	Pressure Ports
A	3.5" Ames Slug	NA
B	3.5" Boeing Slug	NA
C	3.5" Teflon	No Port
D	3.5" PICA - Witness	No Port
E	3.5" PICA	.07 Port
F	3.5" PICA	.05 Port
G	3.5" PICA	.07 Liners
H	3.5" PICA	.05 Liners
I	3.5" PICA	Various

Table 1. Subtask One: Stagnation Test Conditions and Model Descriptions

2.2 (Requirement/Subtask Two):

The Contractor shall perform shear tests to demonstrate the MEDLI/MEADS proof of concept pressure measurements and to evaluate the pressure port interface with the external surface of the heat shield. Some of the models will have up to two active pressure measurement ports and some will have no pressure ports. All models will have at least two thermocouples. Details of the model configurations are presented in Table 2.

The Contractor shall conduct a total of ten (10) test runs to evaluate these parameters. In addition, the contractor will perform a calibration run. Two models of the same geometry as the pressure models, one fabricated from PICA and one fabricated from teflon, will be included on the calibration run. The Teflon model does not have any instrumentation and the PICA model may have up to two thermocouples.

Test Conditions for Subtask Two

The various test conditions required to meet the test objectives are presented in Table 2. Boeing shall select the appropriate nozzle size and facility configuration to match these shear conditions as closely as possible. Boeing shall receive the Langley Arc Jet Test Lead's concurrence on the acceptable test conditions for each run, based on calibrations. The heat flux and stagnation pressure shall be held at a constant value for the duration of the run or until the Langley Arc Jet Test Lead requests that the

model be removed from the flow if before the end of the specified run duration. The Boeing LCAT test director may also terminate the test or remove the model from the flow for facility safety concerns.

A calibration run shall be performed prior to the test run measuring the surface pressure and stagnation heat flux to verify appropriate test conditions. Boeing shall use the wedge plate calorimeter used during the calibration test series. If the conditions are within a predetermined tolerance band (tolerance to be determined) the test models will be installed and the test run will be performed. If the test conditions are not acceptable, Boeing shall attempt to adjust the conditions to meet the test requirements prior to proceeding to the test run.

The Langley Arc Jet Test Lead may request a test matrix change or model change with the understanding that it may impact schedule. The LCAT Test Engineer will be notified 24-hours in advance of any potential changes if possible.

Test Condition	NASA Run Number	Shear Target Test Conditions: Hot wall Heat Flux (W/cm^2)	Cold Wall Heat Flux (W/cm^2)	Shear Stress (Pa)	Surface Pressure (atm)	Test Duration (sec)	Total Energy Load (J/cm^2)	Test Models: Sting Arm 1	2	3	Comment
1	Cal-1	140		155	0.35	35	4900	A	B	C-nc	Calibration - Composite Condition, Max Shear
1	1	140		155	0.35	35	4900	A	D-nc	D-c	Parallel Fibers
1	2	140		155	0.35	35	4900	A	D-c	D-nc	Parallel Fibers
1	3	140		155	0.35	35	4900	A	F-nc	F-c	Fiber Orientation, 16-deg with Flow
1	4	140		155	0.35	35	4900	A	F-c	F-nc	Fiber Orientation, 16-deg with Flow
1	5	140		155	0.35	35	4900	A	H-nc	H-c	Fiber Orientation, 16-deg into Flow
1	6	140		155	0.35	35	4900	A	H-c	H-nc	Fiber Orientation, 16-deg into Flow
1	7	140		155	0.35	35	4900	A	C-nc	C-c	Coating Comparison, Parallel Fibers
1	8	140		155	0.35	35	4900	A	E-nc	E-c	Coating Comparison, 16-deg with Flow
1	9	140		155	0.35	35	4900	A	G-nc	G-c	Coating Comparison, 16-deg into Flow
1	10	140		155	0.35	35	4900	A	TBD	TBD	Reevaluation Run

Model Name	Shear Wedge Model Description: Type	Pressure Ports	Coated	Fiber Orient.
A	Wedge Cal Plate	NA	NA	NA
B	Teflon Cal Plate	NA	NA	NA
C-nc	PICA Witness Plate	No Port	No	Parallel
C-c	PICA Witness Plate	No Port	Yes	Parallel
D-nc	PICA Plate	2-Ports	No	Parallel
D-c	PICA Plate	2-Ports	Yes	Parallel
E-nc	PICA Witness Plate	No Port	No	16-deg* with Flow
E-c	PICA Witness Plate	No Port	Yes	16-deg* with Flow
F-nc	PICA Plate	2 Ports	No	16-deg* with Flow
F-c	PICA Plate	2 Ports	Yes	16-deg* with Flow
G-nc	PICA Witness Plate	No Port	No	16-deg* into Flow
G-c	PICA Witness Plate	No Port	Yes	16-deg* into Flow
H-nc	PICA Plate	2 Ports	No	16-deg* into Flow
H-c	PICA Plate	2 Ports	Yes	16-deg* into Flow

Table 2. Subtask Two: Shear Test Flowfield Conditions and Model Descriptions

Test Articles (Subtasks One and Two)

All test samples will be provided by NASA-Langley. All of the test articles will be preassembled and shipped to Boeing-St. Louis at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test.

Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request.

For **Subtask One**, Boeing shall supply the heat flux/stagnation pressure probes. In addition, Boeing shall provide a sting arm adapter module to allow pressure tube changes.

For **Subtask Two**, Boeing shall supply the heat flux wedge probe. In addition, Boeing shall provide a sting arm adapter module to allow pressure tube changes.

Specimen Holders (Subtasks One and Two)

All test specimen holders will be supplied by NASA.

Specimen Pre-Test Preparation (Subtasks One and Two)

1. Each specimen shall be inspected on receipt for any shipping damage. Any damage shall be reported to the Langley Arc Jet Test Lead and documented.
2. Pre-test photographs shall be taken of each specimen to thoroughly document the pre-test condition.
3. Pre-test weights of the samples shall be made and recorded.
4. Each test specimen shall be kept in a controlled storage area until tested. Positive identification of each test specimen shall be maintained at all times.

Specimen Post-Test Disposition (Subtasks One and Two)

1. The Contractor shall examine the specimen on the sting in the specimen holder after exposure and cool-down.
2. Post-test photographs shall be taken of each specimen inside the chamber if data will be lost from movement of the model. Additionally, photos shall be taken of the model after removal from the test facility.
3. Post-test weights of the samples shall be made and recorded.
4. Post-test recession measurements shall be made at nine different locations on the model surface as determined by the Langley Arc Jet Test Lead.
5. Upon completion of testing and post-test documentation, selected samples as determined by the Langley arc jet test lead shall be appropriately packaged, labeled, and express shipped to NASA-Langley for further examination.

Langley Shipping Address:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

Test Data (Subtasks One and Two)

1.0 Facility operating conditions including enthalpy, pressure, mass flow rate, arc current, arc voltage, etc, shall also be provided to the Langley Arc Jet Test Lead with the final data package or sooner at the discretion of the Contractor.

2.0 Test data shall also be provided electronically to designated recipients (see below, **Test Documentation and Reporting**).

Photographic Coverage (Subtasks One and Two)

The Contractor shall take close-up digital photographs (in addition to overall views discussed above) of any damage or change as the post-test condition of any specimen warrants. Each photograph shall be identified using photo cards and contain the following minimum information:

1. Test Title
2. Test Date
3. Test Number
4. Part Identification Number
5. Pretest/Test/Post-test Chronology
6. Description of View (front, back, side, etc.)

The Contractor shall provide one set of preliminary photographs to the Langley Test Lead upon request. Photographs providing required information shall be included in the Test Report. One set of the archived photographs shall be provided to the Langley Test Lead in the final data delivery.

Video Coverage (Subtasks One and Two)

The Contractor shall video record the model face and side views during the tests to verify model performance. Copies of the test video shall be delivered to the Langley Arc Jet Test Lead in the final data delivery.

2.1.1 Milestones (Optional): No specific milestones pertain to this work.
The Subtask One test matrix is expected to be completed within 7 business days.
The Subtask Two test matrix is expected to be completed within 5 business days.

2.1.2 Deliverables and Schedule (Required):

Test Documentation and Reporting (Subtasks One and Two)

Data may be e-mailed or shipped by mail. In addition, the Contractor shall deliver video and photos (pre and post-test) by e-mail or mail as soon as practical (the same day) following each test to the designated people below:

Name	e-mail address
Walt Bruce	Walter.E.Bruce@ nasa.gov

Kaitlin Liles Kaitlin.A.K.Liles@nasa.gov

Following completion of the test program, the Contractor shall deliver all data and documentation to the Langley Arc Jet Test Lead (including copies of any reports written). The following documentation shall be prepared in a report containing:

1. Pre and post-test weights of each test sample
2. Pre and post-test photographs of each test sample
3. Plots from test runs of temperature and pressure
4. Facility operating conditions (enthalpy, pressure, arc current, arc voltage, mass flow rate, etc.) at a minimum for each test condition. The preferred format is a tabulated set of data in digital format, for each parameter versus time.

The Contractor shall deliver all test data to the Langley Arc Jet Test Lead as soon as possible, but not later than two weeks after the conclusion of the test. All test models shall be shipped to the Langley Arc Jet Test Lead no later than one week after the conclusion of the test.

Return Shipping Addresses

Ship post-test samples, complete report package and all data to:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Subtask One: Stagnation Test

Meets: Ten (10) test runs, per provided test matrix, successfully completed (conditions met to NASA satisfaction, no facility anomalies)

Exceeds: Greater than 10 test runs successfully performed within the test window (conditions met to NASA satisfaction, no facility anomalies)

Subtask Two: Shear Test

Meets: Ten (10) test runs, per provided test matrix, successfully completed (conditions met to NASA satisfaction, no facility anomalies)

Exceeds: Greater than 10 test runs successfully performed within the test window (conditions met to NASA satisfaction, no facility anomalies)

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management

walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: NASA-Langley will provide the TPS samples. All of the TPS test articles will be preassembled and shipped to Boeing-St. Louis at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test. Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request.

4. Other Essential Information:

Contractor personnel shall participate in a Test Readiness Review (TRR) via telecon within 7 business days before each scheduled test start. Telecon arrangements will be made by the Langley Arc Jet Test Lead, in coordination with the Contractor personnel.

Test Notification and Attendance (Subtasks One and Two)

The Contractor shall provide the Langley Arc Jet Test Lead sufficient notice in advance of a test to permit attendance at the test. The Langley Arc Jet Test Lead shall be notified of any changes to the test schedule. The Contractor shall accommodate a representative from Lockheed Martin Space Systems Company to witness the testing in its entirety.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): No security clearances or other special provisions are required, other than the sample handling requirements specified above.

6. Period of Performance:

Planned start date: [TD1] ***August 5, 2008*** Completion date: October 15, 2008

7. NASA Task Management:

Technical Monitor (Required): Walter Bruce

M/S: 431 Phone: 757-864-7024

Other POC (Optional): Michelle Munk

M/S: 468 Phone: 757-864-2314

TASK ORDER NUMBER: 021D2-NNL08AM25T Revision: 0 Change: 0 Date: August 21, 2008

Title: LCAT Stagnation and Shear Qualification Tests for MEDLI

1. Purpose, Objective, or Background (Optional)

Background

The Mars Science Laboratory (MSL), scheduled for launch in 2009, will incorporate pressure measurement instrumentation in the heat shield to measure the surface pressure response during the Entry, Descent, and Landing (EDL) phase in the Martian atmosphere. The MSL Entry, Descent, and Landing Instrumentation (MEDLI) / Mars Entry Atmosphere Data System (MEADS) program will incorporate pressure ports through the external heat shield connected to pressure transducers internal to the spacecraft to measure the pressure response on the surface of the heat shield.

The Thermal Protection System (TPS) heat shield for MSL will be fabricated from Phenolic Impregnated Carbon Ablator (PICA) material. The MEDLI/MEADS program performed a series of stagnation and shear development tests in the Boeing Large Core Arc Tunnel (LCAT) between March and September 2008 to design, develop, and evaluate pressure ports in a PICA heatshield material under simulated reentry heating conditions in tasks NNL08AM10T, ...22T, and ...23T, contract NNL07AA00B. . Specifically, the interaction of the pressure port at the surface interface with the PICA material was evaluated under stagnation and shearing conditions to demonstrate acceptable performance at maximum (plus three-sigma) predicted flight entry conditions. In addition, surface pressure was measured through the pressure port holes to demonstrate acceptable pressure measurement performance of the pressure port during entry conditions.

The qualification series of tests contained in this Statement of Work will demonstrate acceptable pressure port performance in both stagnation and shear entry conditions using flight-lot PICA and flight-like fabrication processes. The test models will be fabricated by Lockheed-Martin Space Systems Company (LMSSC) using processes and procedures similar to flight fabrication techniques. All qualification testing will be performed in the Boeing LCAT facility using the same nozzle and heater configurations that were used for all of the development testing.

Test Objectives

Subtask One: To qualify the pressure port flight configuration at relevant stagnation entry conditions, and obtain data on the pressure port performance as described below. The test conditions will be the same conditions that were used during the stagnation development testing series.

Subtask Two: To qualify the pressure port flight configuration at relevant shear entry conditions, and obtain data on the pressure port performance as described below. The test conditions will be the same conditions that were used during the shear calibration and development testing series.

Technical Direction 1 (9/24/08): Updates the initial task order start date to September 24, 2008 as issued by the CO on 9/23/08 (see [TD1] below, Section 6).

2. Description of the Work to be Performed:

The Contractor shall perform a stagnation qualification effort using 3.5-inch diameter PICA models (Subtask One), and a shear qualification test effort using 3.0 x 3.0-inch PICA wedge model configurations (Subtask Two). Some of the models will have active pressure measurements and thermocouples.

2.1 (Requirement/Subtask One): Stagnation Qualification Test

A total of ten (10) PICA models shall be tested. Specifically, six (6) 3.5-inch diameter PICA samples with one active pressure port per model and four (4) thermocouples per model and four (4) witness models (no pressure port holes) with four (4) thermocouples shall be tested. In addition to testing the PICA models, the following models are required for flow-field calibration:

1) The "Ames" 3.5-inch stagnation slug calorimeter with stagnation pressure measurement.

2) The "Boeing" 3.5-inch stagnation slug calorimeter with stagnation pressure measurement.

3) 3.5-inch Teflon calibration models.

The Contractor shall provide items 1) and 2), above. NASA will provide item 3).

The Langley Arc Jet Test Lead may request a test matrix change or model change with the understanding that it may impact schedule. The LCAT Test Engineer will be notified 24-hours in advance of any potential changes if possible.

Test Conditions for Subtask One

Two different test conditions are required. They are:

Stagnation Test Condition #1:
Surface Pressure = 0.38 atm
Hot Wall Heat Flux = 55 W/cm^2
Heat Load = 2200 J/cm^2

Stagnation Test Condition #2:
Surface Pressure = 0.32 atm
Hot Wall Heat Flux = 110 W/cm^2
Heat Load = 3900 J/cm^2

Five of the PICA models shall be tested at each condition.

Test Articles for Subtask One

In addition to the heat flux/stagnation pressure probes noted as items 1) and 2), above, Section 2.1, the Contractor shall provide a sting arm adapter module to allow pressure tube changes.

NASA will provide all PICA test models, and the stagnation Teflon models. All NASA-provided test articles will be preassembled and shipped to the Contractor test site at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test.

Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request.

Specimen Holders for Subtask One

NASA will provide all test specimen holders.

2.2 (Requirement/Subtask Two): Shear Qualification Test

A total of ten (10) PICA models shall be tested. Specifically, six (6) 3.0 x 3.0-inch PICA samples with one active pressure port per model and up to two thermocouples and four (4) witness samples (no pressure port holes) with up to two (2) thermocouples per model shall be tested. In addition to testing the PICA samples the following models are required for flow-field calibration.

1) A calorimeter plate to measure surface heat flux with sufficient distribution of heat flux gages on the surface to adequately map the surface heating profile (a suggested design, used previously for shear nozzle calibration, is shown in Figure 1).

2) A pressure plate to measure the surface pressure with sufficient distribution of pressure taps to adequately map the surface pressure profile (a suggested design, used previously for shear nozzle calibration, is shown in Figure 1).

3) A Teflon plate to determine flow uniformity and surface heating. The nominal Teflon density shall be 135.0 lbm/ft3.

The Contractor shall provide items 1), 2), and 3) above. NASA will provide the 3.0 x 3.0-inch PICA test samples.

The Contractor shall perform various calibration runs as needed, exposing the calorimeter plate and the pressure plate to the flow to evaluate the flow conditions, until it has been determined that the closest match of pressure and heat flux have been achieved. When the Contractor and the NASA Langley Arc Jet Test Lead have jointly determined that no further refinement of the arc heater conditions will improve the test simulation or the required surface pressure and heat flux have been met, then the PICA samples shall be tested using the calibrated heater condition.

The Langley Arc Jet Test Lead may request a test matrix change or model change with the understanding that it may impact schedule. The LCAT Test Engineer will be notified 24-hours in advance of any potential changes if possible.

Test Conditions for Subtask Two

The required test conditions are:

Surface Pressure = 0.25 atm
Hot Wall Heat Flux = 110 W/cm^2
Surface Shear Stress = ~300 Pa
Heat Load = 3885 J/cm^2

Test Articles for Subtask Two

The Contractor shall provide the calorimeter plate, pressure plate, and Teflon calibration samples for the shear tests. The calorimeter and pressure plates shall have sufficient heat flux gages and pressure taps to sufficiently map the surface conditions. The pressure taps and heat flux gages will be installed in identical locations on the plates as shown in Figure 1. These are the same pressure and calorimeter plate designs used during the development efforts.

NASA will provide all PICA test models, and the stagnation Teflon models. All of the NASA-provided test articles will be preassembled and shipped to the Contractor test site at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test.

Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request.

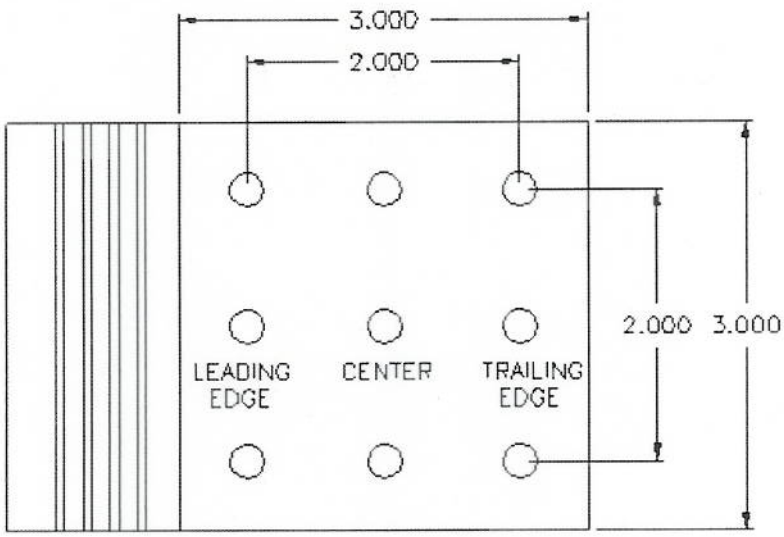


Figure 1. Distribution of calorimeter and pressure taps on 3" x 3" calibration plates.

Specimen Holders for Subtask Two

The Contractor shall provide the wedge model holders.

Specimen Pre-Test Preparation (Subtasks One and Two)

1. Each specimen shall be inspected on receipt for any shipping damage. Any damage shall be reported to the Langley Arc Jet Test Lead and documented.

2. Pre-test photographs shall be taken of each specimen to thoroughly document the pre-test condition.

3. Pre-test weights of the samples shall be made and recorded.

4. Each test specimen shall be kept in a controlled storage area until tested. Positive identification of each test specimen shall be maintained at all times.

Specimen Post-Test Disposition (Subtasks One and Two)

1. The Contractor shall examine the specimen on the sting in the specimen holder after exposure and cool-down.

2. Post-test photographs shall be taken of each specimen inside the chamber if data will be lost from movement of the model. Additionally, photos shall be taken of the model after removal from the test facility.

3. Post-test weights of the samples shall be made and recorded.

4. Post-test recession measurements shall be made at nine different locations on the model surface as determined by the Langley Arc Jet Test Lead.

5. Upon completion of testing and post-test documentation, selected samples as determined by the Langley arc jet test lead shall be appropriately packaged, labeled, and express shipped to NASA-Langley for further examination.

Langley Shipping Address:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

Test Data (Subtasks One and Two)

1.0 Facility operating conditions including enthalpy, pressure, mass flow rate, arc current, arc voltage, etc, shall also be provided to the Langley Arc Jet Test Lead with the final data package or sooner at the discretion of the Contractor.

2.0 Test data shall also be provided electronically to designated recipients (see below, **Test Documentation and Reporting**).

Photographic Coverage (Subtasks One and Two)

The Contractor shall take close-up digital photographs (in addition to overall views discussed above) of any damage or change as the post-test condition of any specimen warrants. Each photograph shall be identified using photo cards and contain the following minimum information:

1. Test Title
2. Test Date
3. Test Number
4. Part Identification Number
5. Pretest/Test/Post-test Chronology
6. Description of View (front, back, side, etc.)

The Contractor shall provide one set of preliminary photographs to the Langley Test Lead upon request. Photographs providing required information shall be included in the Test Report. One set of the archived photographs shall be provided to the Langley Test Lead in the final data delivery.

Video Coverage (Subtasks One and Two)

The Contractor shall video record the model face and side views during the tests to verify model performance. Copies of the test video shall be delivered to the Langley Arc Jet Test Lead in the final data delivery.

2.1.1 Milestones (Optional): No specific milestones pertain to this work. The test dates will be agreed upon by NASA and the Contractor.

The Subtask One testing is expected to be completed within 4 business days.

The Subtask Two testing is expected to be completed within 4 business days.

2.1.2 Deliverables and Schedule (Required):

Test Documentation and Reporting (Subtasks One and Two)

Data may be e-mailed or shipped by mail. In addition, the Contractor shall deliver video and photos (pre and post-test) by e-mail or mail as soon as practical (the same day) following each test to the designated people below:

Name	e-mail address
Walt Bruce	Walter.E.Bruce@ nasa.gov
Kaitlin Liles	Kaitlin.A.K.Liles@nasa.gov

Following completion of the test program, the Contractor shall deliver all data and documentation to the Langley Arc Jet Test Lead (including copies of any reports written). The following documentation shall be prepared in a report containing:

1. Pre and post-test weights of each test sample
2. Pre and post-test photographs of each test sample
3. Plots from test runs of temperature and pressure
4. Facility operating conditions (enthalpy, pressure, arc current, arc voltage, mass flow rate, etc.) at a minimum for each test condition. The preferred format is a tabulated set of data in digital format, for each parameter versus time.

The Contractor shall deliver all test data to the Langley Arc Jet Test Lead as soon as possible, but not later than two weeks after the conclusion of the test. All test models shall be shipped to the Langley Arc Jet Test Lead no later than one week after the conclusion of the test.

Return Shipping Addresses

Ship post-test samples, complete report package and all data to:

Walt Bruce or Kaitlin Liles
NASA Langley Research Center
1 North Dryden Street
Mail Stop 431, Bldg. 1209
Hampton, VA 23681-2199

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Subtask One: Stagnation Qualification Test

Meets: Ten (10) samples successfully tested (conditions met to NASA satisfaction, no facility anomalies)

Exceeds: Greater than 10 samples successfully tested within the test window (conditions met to NASA satisfaction, no facility anomalies)

Subtask Two: Shear Qualification Test

Meets: Ten (10) samples successfully tested (conditions met to NASA satisfaction, no facility anomalies)

Exceeds: Greater than 10 samples successfully tested within the test window (conditions met to NASA satisfaction, no facility anomalies)

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: NASA-Langley will provide the TPS samples. All of the TPS test articles will be preassembled and shipped to the Contractor test site at least 24 hours prior to the test. The Langley Arc Jet Test Lead will confirm proper test configuration of samples prior to performing the test. Material Safety Data Sheets for the tested materials will be provided to the LCAT test director upon request.

4. Other Essential Information:

Contractor personnel shall participate in a Test Readiness Review (TRR) via telecon within 7 business days before each scheduled test start. Telecon arrangements will be made by the Langley Arc Jet Test Lead, in coordination with the Contractor personnel.

Test Notification and Attendance (Subtasks One and Two)
The Contractor shall provide the Langley Arc Jet Test Lead sufficient notice in advance of a test to permit attendance at the test. The Langley Arc Jet Test Lead shall be notified of any changes to the test schedule. The Contractor shall accommodate a representative from Lockheed Martin Space Systems Company to witness the testing in its entirety.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): No security clearances or other special provisions are required, other than the sample handling and control requirements specified above.

6. Period of Performance:

Planned start date: [TD1] ***September 24, 2008*** Completion date: December 15, 2008

7. NASA Task Management:

Technical Monitor (Required): Walter Bruce
M/S: 431 Phone: 757-864-7024
Other POC (Optional): Michelle Munk
M/S: 468 Phone: 757-864-2314

1.0 Purpose, Objective, Scope, and Background

1.1 Purpose of the Work

a) The purpose of this work is to provide Internal Audit support for the Langley Research Center.

1.2 Objectives

a) Meet the Center's requirement for the conduct of internal audits.
   i) Evaluate compliance of the Center's documented processes and procedures with applicable requirements (e.g., ISO 9001, AS9100, Agency Directives, and other governmental/regulatory authorities).
   ii) Evaluate performance of Center's operations for compliance with the documented processes and procedures.
   iii) Conduct topic specific internal audits as mandated by external authorities.
b) Provide objective recommendations that are based on audit evidence
   i) Recommendations to improve the Center's processes and procedures
   ii) Recommendations to improve the Center's operational compliance with processes and procedures
   iii) Recommendations to correct deficiencies identified by audit findings

1.3 Scope

The scope of this work includes:

a) Internal audits of all the Center's processes and procedures, as documented in the Langley Management System (LMS)
b) Topic specific internal audits as mandated by NASA HQ and other governmental authorities

NOTE: The scopes of internal audits under this Task DOES NOT include financial audits.

1.4 Background

a) NASA Langley Research Center (LaRC) is a world class Aerospace Government laboratory with a Mission to Pioneer the Future in Space Exploration, Scientific Discovery, and Aeronautics through Research and Development of Technology, Scientific Instruments, and Exploration Systems. The Center workforce includes approximately 2000 Civil Service Employees as well as various contractors that support its operations.

b) The Center currently holds a dual ISO9001/AS9100 registration. The ISO scope includes "…all Civil Service operations and activities associated with design, analysis, development, and delivery of aerospace vehicle systems technologies and scientific research of all planetary atmospheres…" The AS9100 scope includes "…processes and services that support the design, development, fabrication, component assembly, and system installation of flight hardware, flight software, and associated ground support equipment interfacing with flight hardware and flight software…"

c) The Center's Internal Audit Program Manager (IAPM) has over all responsibility for the Center's Internal Audit Program (IAP) and will serve as the Technical Monitor for work preformed under this task order. The position of IAPM is an inherently government responsibility and the designated Responsible NASA Official (RNO) is Mr. Albert E. Motley III.

d) The incumbent Internal Auditor is currently a NASA Civil Servant responsible for the day to day operations of the IAP. The incumbent ensures the day to day IAP operations are in compliance with ISO9001, AS9100, and other applicable Langley directives. The incumbent does not have an

operational staff and performs most work directly. However, the incumbent must coordinate internal audit activity with the IAPM, members of the LMS Points of Contact Team (LMS POC Team), and representatives of the audited organizations.

The Government desires to transfer work for the day to day operations of the IAP to a contractor and considers the tasks described in section 2.0 of this PWS as requiring the full time assignment of an Internal Auditor.

1.5 Desired Internal Auditor Qualifications and Coordination:

a) Certification as an Internal Auditor by an International Accreditation Foundation (IAF) organization that is recognized by the United States ISO 9001/AS9100 Registration Body.
b) Previous auditing experience with experience auditing government organizations highly desired.
c) Available copies of applicable certifications and a summary of prior audit experience prior to the start of work.
d) Open discussion concerning staffing selection.

Technical Direction 1 (9/16/08): Updates the initial task order start date to September 15, 2008 as issued by the CO on 9/15/08 (see [TD1] below, Section 6).
Revision 1 (12/03/08): Shortens the period of performance three months to September 30, 2009 due to NASA funding constraints and proposed Contractor staffing changes and corrects 12-month references to 18 (see [R1] below).

2.0 Description of the Work to be Performed:

In general the Internal Auditor is responsible for the planning and execution of internal audits, tracking of audit findings, evaluating effectiveness of corrective actions, and maintaining records & trend analyses of IAP operations. Relevant Center processes and procedures include:

a) LMS-CP-2305 "LMS Internal Assessment."
b) LMS-CP-2303 "Corrective, Preventive, and Improvement (CPI) Action, Review and Tracking"

2.1 Sub-Task 1: Plan Internal Audits:

The Internal Auditor shall

a) Develop an Annual Internal Audit Plan
   i) The plan shall be developed and maintained in compliance with the Center's Internal Audit process and procedures.
   ii) The plan shall cover the Center's Management System, ISO9001/AS9100 requirements, and other internal audit requirements as mandated by external authorities.
   iii) The plan shall establish a series of Individual Internal Audits such that the entire LMS is audited over [R1]***an 18-month period***.
   iv) The plan shall be submitted to the IAPM for review and approval
b) Report status and issues relating to the Annual Internal Audit Plan in accordance with sub-task 9
c) Develop Individual Internal Audit Plans
   i) The plans shall be developed and maintained in compliance with the Center's Internal Audit processes and procedures
   ii) The plans shall identify the organization and requirements being audited
   iii) The plans shall be coordinated with the affected Organizations
   iv) The plans shall be submitted to the IAPM for review and approval
d) Report status and issues relating to Individual Internal Audit Plans in accordance with sub-task 8

2.2 Sub-Task 2: Conduct Internal Audits

The Internal Auditor shall:

a) Perform the duties and responsibilities associated with the role of Lead Auditor.
b) Conduct Internal Audits in accordance with Center processes and procedures.
    i) Conduct Desk Audits of relevant processes and procedures
    ii) Conduct audit interviews
    iii) Collect and evaluate Objective Evidence
    iv) Use the AS9101 Audit Checklist (or equivalent as approved by the IAPM)
c) Present audit results and findings to the leadership of the organization audited
d) Enter audit findings into CAPTracs
e) Conduct audit customer satisfaction surveys
f) Compile individual internal audit work packages
g) Report status and issues relating to the conduct of Internal Audits in accordance with sub-task 8

2.3 Sub-Task 3: Conduct Follow-up Internal Audits:

The Internal Auditor shall:

a) Perform the duties and responsibilities associated with the role of Follow-up Auditor.
b) Evaluate proposed Corrective, Preventative, and Improvement (CPI) plans
c) Recommend appropriate revision/acceptance of plans to the IAPM
d) Monitor implementation of corrective action plans
e) Verify effectiveness of completed corrective action plans
f) Update CAPTracs accordingly
g) Report status and issues relating to corrective action plans in accordance with sub-task 8

2.4 Sub-Task 4: Support External Audits

The Internal Auditor shall:

a) Participate in the planning of external audits (e.g., on request participate in the planning of the Center's semi-annual ISO/AS9100 Surveillance audits)
b) Participate in the conduct of external audits (e.g., on request serving as escort for the external auditors, assisting in the collection of objective evidence)
c) Enter audit findings into CAPTracs
d) Participate in the briefings, meetings, and presentations regarding external audits (e.g., on request participate in the audit closing briefing and subsequent CLC briefings)
e) Report status and issues relating to external audits in accordance with sub-task 8

2.5 Sub-Task 5: Operate the Corrective, Preventative, and Improvement Action Tracking System (CAPTracs)

The Internal Auditor shall:

a) Maintain accurate and up-to-date information in the CAPTracs system.
b) Facilitate the effective flow of work products as other Organizations work their assigned actions through the CAPTracs system.
c) Report status and issues relating to the CAPTracs system in accordance with sub-task 8
    NOTE: maintenance of the CAPTracs web server and web applications are outside the scope of this task order. However, the incumbent is expected to coordinate and cooperate with the server and application managers to help resolve issues.

2.6 Sub-Task 6: Records and Data Analysis

The Internal auditor shall:

a) Maintain accurate and up-to-date records in compliance with the Center's Internal Audit processes and procedures.
b) Develop and maintain trend analyses (e.g., Performance of the IAP; Trends of the Internal Audit Findings with a focus on identifying and understanding areas of reoccurring findings; Status and progress of CPI Actions including statistics on open and closed actions)

NOTE: All data and records generated by work performed under this PWS are the property of NASA.

Preliminary 2.7 Sub-Task 7: Provide subject matter expertise and consulting

(Deleted 9/4/08 due to OCI concerns)

2.7 Sub-Task 7: Continuous Improvement

The Internal Auditor shall:

a) Strive to continuously improve the efficiency and effectiveness of the day to day IAP operations
   i) Conduct a Quarterly evaluation of the IAP operational effectiveness and efficiency
   ii) Compare Langley's IAP operations against industry standards
   iii) Perform an annual benchmark against at least one other NASA Center
b) Monitor routine performance of the day to day operations
   i) Develop new/improved IAP performance measures
   ii) Ensure performance measures provide useful insight into the effectiveness and efficiency of the day to day operations
   iii) Collect, analyze, and trend the performance data
   iv) Identify any deficiencies and develop corrective measures
c) Develop recommended corrective/preventative/improvement measures to address deficiencies
d) Report status and issues relating to continuous improvement in accordance with sub-task 8

2.8 Sub-Task 8 Communications and Reporting

The Internal Auditor shall:

a) Maintain frequent communications with the IAPM:
   i) Communicate immediately with the IAPM on issues affecting the Center's Internal Audit Program relating to sub-tasks 1 through 8
   ii) Provide an informal (verbal) summary once a week on the status, pending changes, and issues relating to sub-tasks 1 through 8
   iii) Provide a formal (written) summary once a month on the status, pending changes, and issues relating to Sub-Tasks 1 through 8
b) Brief the appropriate levels of Center Management:
   i) Participate in senior level briefings on matters relating to Sub-Tasks 1, 6, and 7.
   ii) Participate in line and functional level briefings relating to Sub-Tasks 2, 3, and 6.
c) Coordinate Center wide Internal Audit related communications:
   i) Generate and submit Center wide announcements regarding Internal Audit Plans.
   ii) Generate and submit Center wide announcements regarding the results, findings, and lessons learned from each internal audit.
   iii) Review internal audit related articles submitted to @Larc, the Center's online newsletter.
   iv) Recommend appropriate revisions/acceptance of the articles to the IAPM.
d) Conduct Internal Audit related training:

i) Develop short (approximately one hour in duration) orientation type presentations (e.g., Introduction to CAPTracs, Organizational Readiness for Internal Audits, Audit Roles and Responsibilities of LMS POCs).
ii) Coordinate opportunities for presentations (e.g., new employee orientations, All Hands meeting, Directorate level staff meetings).
iii) Ensure all Center Organizations can effectively utilize the CAPTracs system.

e) Support IAPM reporting on Internal Audits (e.g., on request participate in meetings with the audited organizations, the Center Management Council, and the Center Leadership Council)

2.n Sub-Task n: Working Environment Safety and Organization

a) The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.A Milestones:

a) Annual Internal Audit Planning — Annually no later than September 1st *
b) Spring ISO/AS9100 Surveillance Audits — Annually no later than May 1st
c) Fall ISO/AS9100 Surveillance Audits — Annually no later than November 1st

* waiver for late milestone granted during contract start-up year

2.B Deliverables and Schedule:

NOTE: All deliverables (except Item 4) shall be in electronic format (PDF file or native Microsoft application format).

Item	Sub-Task(s)	Description	Schedule
1	1	Annual Internal Audit Plan A [R1] ***18*** month plan that reflects when Individual Internal Audit and externally mandated audits are scheduled. Plan spans a rolling [R1] ***18*** month window which is updated each month	Ongoing – the initial Annual plan is due within 5 working days after task start –updates are due during the last weekly meeting of the month
2	1	Individual Internal Audit Plans A detailed schedule of the organizations to be audited, the audit criteria to be covered, and the individuals to be interviewed. Individual Internal Audits have a scope that generally covers only one organization, one project, or one specific cross cutting function.	Ongoing – due at least 5 working days prior to negotiated date of the schedule internal audit
3	2	Individual Audit Work Packages Work packages include: the "as completed" audit plan; the annotated checklist used during the audit; relevant objective evidence collected during the audit; interview records and notes (hand written is acceptable); listing of the audit findings, observations, and recommendations; and the final audit report	Ongoing – due within 10 working days after completion the audit interview/data collection phase
4	1B 8a)ii)	Verbal Summary Report An informal discussion with the IAPM, generally scheduled for an hour or less. The objective is to provide a regularly schedule opportunity for the Internal Auditor	Weekly – due during the weekly meeting with the IAPM

		and the IAPM to coordinate on matters relating to the day-to-day operations of the Internal Audit Program	
5	1B 8a)iii)	Written Summary Report A written summary, generally covering the previous 30 days of operations. The purpose is to document and report on work performed under this task order. A relatively simple report is preferred – something with approximately 2 to 3 pages of narrative on the work performed plus charts of the performance and trend analysis.	Monthly – due during the last weekly meeting of the month
6	2 6b) 7b)	Internal Audit Trend Analysis Report A short written narrative of the trends observed in Internal Audits. Requires development of suitable performance measures and simple trend charts related to the performance measures. Candidate measures shall be developed in coordination with the IAPM (e.g., number of audits performed per plan, average duration of audits per organization size, average findings, findings by clause number)	Monthly – due during the last weekly meeting of the month. To allow for the effective transfer and stabilization of day-to-day operations, the first Internal Audit Trend Analysis Report is not required during the first two months after task start.
7	3 5	CAPTracs contents updated The entry of audit findings into CAPTracs. Including making appropriate entries as auditor, lead auditor, and follow up auditor to ensure other organizations process assigned actions within the allocated time.	Ongoing – a summary status of all open action is expected during the weekly verbal reports and monthly written reports
8	5 6b) 7b)	CAPTracs Trend Analysis Report A short written narrative of the trends observed in the CAPTracs system. Requires development of suitable performance measures and simple trend charts related to the performance measures. Candidate measures shall be developed in coordination with the IAPM. (e.g., number of open actions in the system, average time to close an action, actions by clause number)	Monthly – due during the last weekly meeting of the month. To allow for the effective transfer and stabilization of day-to-day operations, the first CAPTracs Tend Analysis Report is not required during the first two months after task start
9	6a)	Internal Audit Records All Internal Audit records are maintained in accordance with NPD 1440.6, NPR 1441.1, and CID 1440.7. Records are delivered by uploading to a government provided on-line archive with an accompanying email sent to the IAPM. The contractor shall maintain backup records on CD-ROM in a government provided filing cabinet. Records pre-dating 1 September 2008 are currently maintained in a government provided file cabinet. Work is in progress to submit existing hard copy records to the Langley Technical Library for conversion to electronic format (PDF), which are returned on a CD-ROM. The contractor shall upload the converted records to the on-line archive and retain the CD-ROM in the backup records.	Ongoing – records are generated and retained as part of the day-to-day operations
10	7a)	Quarterly Evaluation Report A written report that focuses on continuous improvement of the IAP day-today operations. A relatively simple report is preferred – something with approximately 3 to 5 pages of narrative on the results of the most recent Quarterly evaluation of the IAP operational effectiveness and efficiency. It should also	Quarterly – due within one week of completing a quarterly evaluation. To allow for the effective transfer and stabilization of day-to-day operations, the first quarterly

		include results on comparing Langley IAP operations against industry standards as well as a summary of any benchmarking completed since the previous report.	the first quarter after task start.
11	7a)	Annual Benchmarking Report A written report that focuses on the continuous improvement of the IAP day-today operations. A relatively simple report is preferred – something with approximately 3 to 5 pages of narrative on the results of the most recent Quarterly evaluation of the IAP operational effectiveness and efficiency. It should also include results on comparing Langley IAP operations against industry standards as well as a summary of any benchmarking completed since the previous report.	Annually – due within three weeks of completing a benchmarking visit. The first benchmarking visit shall be conducted within the first 6 months after task start.

NOTE 1: Delivery of plans, work packages, and reports are required in electronic (PDF) format with scanned signatures of the originals or digitally approved signatures of the electronic copies. Delivery of interim or review copies of plans, work packages, and written are required in electronic format using Microsoft applications consistent with Center protocols or Center forms defined within established processes and procedures.

2.C Performance Metrics/Standards (Required - Meets, Exceeds):

Sub-Task	Metric/Description	Required	Meets	Exceeds
1	a) Completeness of the plan b) Updates of the Plan	a) Plan covers the entire LMS System b) Timely delivery of the plan updates	a) All organizations and all auditable clauses are covered in the [R1] ***18*** month planning window b) plan updates are delivered during the last meeting of the month	Plan effectively integrates scheduling of audits with organizational workloads so as to minimize disruption of production
2	a) Timeliness of completing internal audits b) Customer satisfaction feedback	a) Individual audits are planned and conducted per the Annual Plan b) Customer feedback survey	a) audits completed as scheduled b) 5% or fewer negative comments or complaints during the previous quarter	a) audit scheduled are adjusted to accommodate customer's short term schedule constraints b) no negative customer feedback during the previous quarter
3	a) Completeness of the follow-up audits b) Timeliness of completing follow-up audits	a) follow-up audits are completed for all CPI actions in the CAPTracs b) follow-up audits are completed with in 5 working days	a) follow-up audits verify CPI action effectiveness b) 90% of the follow-up audits are completed with in 10 working days of CAPTracs notification and no follow-up audits are completed later than 20 working days after CAPTracs notification.	a) auditor works with CPI action designee to ensure implementation plan is appropriate and has a high probability of effectiveness b) 95% follow-up audits are completed within 5 working days of CAPTracs notification and no follow-up audits are completed later that 10 working days after CAPTracs notification
4	a) supports planning of external audits	a) participates in audit planning b) assists external	a) offers knowledge and insight gained through the conduct of internal audits to assist in the planning of external audits	a) effectively helps minimize disruption to the audited organization

	of external audits	auditors	b) escorts external auditors to scheduled interviews	b) assists in the collection of objective evidence
5	A) Effective and efficient operation of the CAPTracs System	a) can enter and maintain information in the system with minimal assistance from the IAPM or system administrators b) assists designees in other organizations in the operation of CAPTracs	a) Develops effective working knowledge of the CAPTracs system b) works with other organizations to ensure designees develop their own effective working knowledge of CAPTracs	a) actively engages the systems administrators to evaluate and improve how CAPTracs operates b) conducts training to assist other organizations in the operations of CAPTracs
6	a) maintains internal audit records b) conducts trend analyses	a) maintains internal audit records in accordance with Center processes and procedures b) compiles data and conducts trend analysis of key IAP, CAPTracs, and Internal Audit performance measures	a) internal audit records are complete and requested records are provided within 24 hours b) trend analysis are complete and provided as required during weekly and monthly reports.	a) internal audit records ad available immediately upon request b) continuous effort to improve trend analyses (provide better performance insight with less analysis effort) c) trend analyses are used to drive continuous improvement efforts
7	a) strives to continuously improve the IAP day-to-day operations	a) uses trend analysis and process control methods to continuously improve IAP day-to-day operations	a) presents data and trend analysis to explain performance of the IAP day-to-day operations	a) shows 10% or better improvement in performance measure as compared to the previous reporting period
8	a) effectiveness in communicating	a) maintains frequent contact with the IAPM	a) keeps the IAPM informed on matters that affect the IAP b) makes clear, concise, and relevant presentations/briefings c) effectively uses available media (e.g., email, @LaRC, websites) to share internal audit related information	a) plans and conducts training to help organizations prepare of internal audits b) plans and conducts training that helps organizations improve their processes and procedures (from an audit standpoint)
n	a) maintains safe and organized working environment	a) working environment conforms to Center policy and procedures	a) no safety incidents or violations in the past 30 days	a) no safety incidents or violations in the past 12 months

3.0 Government Furnished Items:

a) The government will provide office space, standard office furniture, and telephone service
b) The government will NOT provide computer resources, general office supplies, and reproduction facilities.
c) The government will provide copies of, or access to, all relevant government owned or controlled information (e.g., directives, publications, and existing training materials) as necessary to perform work under this order.
d) The government will provide necessary, available and reasonable access to functional personnel.
e) The government will sponsor and facilitate the contractor's application for user accounts on relevant systems and servers.

4.0 Other Essential Information:

4.1 Travel:

Limited travel is expected in support of this order.

a) All travel shall be in accordance with the Joint Travel Regulations.
b) Authorization to travel must be approved by the IAPM
c) Current travel expectations include:
   i) Annual benchmarking activity at other NASA Centers (duration not to exceed one week).
   ii) Twice Annual meetings in support of Agency related working groups (working group meetings are generally 3 to 5 working days)
   iii) Annual professional development conference relating to ISO/AS9100 (duration not to exceed one week)
   iv) Annual professional development conference relating to Internal Auditing (duration not to exceed one week)

5.0 Security Clearance, ITAR, OCI, and Other Special Handling Issues:

a) Personnel working on this order shall comply with all Langley security policies and regulations
b) Information and material processed under this order will not exceed the level of "Sensitive But Unclassified."
c) Personnel working on this order shall maintain an active non-disclosure-agreement with the government (agreements at the contract level or at the task order level are equally acceptable)

6.0 Period of Performance:

Planned start date: TD1 ***September 15, 2008*** Completion date: R1 ~~December 31, 2009~~ ***September 30, 2009***

The government expects to continue this task on an annual basis.

7.0 NASA Task Management:

Technical Monitor
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Senior Systems Engineer
Systems Management Office
NASA Langley Research Center
Hampton, V.A. 23681
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Alternate Point of Contact
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TASK ORDER NUMBER: 072D3-NNL08AM27T Revision: 0 Change: 0 Date: September 3, 2008

Title: NTF Flow Quality Characterization for Laminar Flow Testing

1. Purpose, Objective, or Background (Optional)

The National Transonic Facility (NTF) is a world-class cryogenic wind tunnel facility located at NASA Langley Research Center. Current and future testing demands at this facility require assessment of the flow quality for the purposes of testing laminar flow technologies at relevant operating conditions. The reported assessment will provide useful information for potential customers interested in testing laminar flow or boundary layer transition sensitive articles in the NTF. The assessment will reference and compare to previously published guidelines for laminar flow technology testing.

This task includes the application of state of the art testing technologies for flow quality measurements as well as innovative research and development of new procedures and technologies for the purpose of flow quality characterization in NTF. This task will require staffing by personnel with demonstrated expertise in both flow quality measurements and laminar flow technologies.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Direct Measurement of Velocity and Pressure Perturbations:

The Contractor shall perform multiple point pressure and velocity measurements in the NTF to characterize the baseline velocity and pressure perturbation fields for the purposes of flow quality characterization for laminar flow testing. The measurements shall be acquired over a range of conditions in the NTF covering Mach numbers (M) of $0.2 \leq M \leq 0.9$, and Reynolds numbers (Re) of Re/ft ranging from 3 million to 70 million. Testing should be conducted at both warm and cryogenic conditions. A run schedule shall be prepared and submitted to the technical monitor for approval prior to the test. Please note that one week of testing with two shifts per day has been allocated for this task.

The test report shall be prepared and be consistent with AIAA 94-2503 and shall include a comparison to other transonic wind tunnel flow quality data. The test report shall also compare NTF results with the guidelines given in NAS3-27330, Document No. DB-1-026, "Flow Quality Requirements for Laminar Flow Testing."

The Contractor shall purchase 6 cryogenic-rated unsteady pressure transducers and install the transducers in existing support hardware appropriate for the testing.

2.1.1 Deliverables and Schedule

a.) Pretest report due 2 weeks prior to pretest meeting.
b.) Pretest meeting approximately 1 month prior to expected test start
c.) Test report due 60 days after completion of the test.

2.1.2 Performance Evaluation Criteria

Meets: Contractor meets the schedule as stated and processes all data for single point time series analysis prior to report due date.
Exceeds: Two point time series analysis and/or higher order analyses are included in the test report.

2.2 Design of Generic Transition Calibration Body for Flow Quality Assessment:

The Contractor shall conduct feasibility studies and design a generic transition body for laminar flow testing calibration of facilities. The feasibility and design shall consider both T-S (Tollmien-Schlichting)

type transition and crossflow type transition through stability analysis. Effects such as surface roughness and characteristic wavelengths shall be considered.

2.2.1 Deliverables and Schedule

a.) Complete design of a generic transition body shape by July 1, 2009

b.) Documented analysis of the expected performance of the transition body by July 1, 2009

c.) Status review of design progress by March 31, 2009

2.2.2 Performance Evaluation Criteria

Meets: All subtask deliverables completed on schedule.

Exceeds: Subtask deliverables completed ahead of schedule. Design features or enhancements such as inclusion of conventional embedded sensor arrays and self-contained data acquisition arrays are included for transition body. Analysis of expected performance of transition body for Ames 11' facility is included in documentation.

2.3 Development of Advanced Transition Detection Techniques for Generic Transition Calibration Body

The Contractor shall investigate advanced transition detection measurement techniques to be implemented into the design of the generic transition body. The measurement techniques shall include unsteady pressure measurement technology and unsteady shear stress measurement technology. The Contractor shall develop a design and fabrication process for the integration of on-chip sensing elements for unsteady shear stress sensing elements.

2.3.1 Deliverables and Schedule

a.) Report documenting the characterization of the bandwidth and dynamic range of advanced unsteady pressure measurement transducer arrays by September 30, 2009.

b.) Report documenting the on-chip sensing element design and characterization of the bandwidth and dynamic range of the advanced shear stress sensors by September 30, 2009.

2.3.2 Performance Evaluation Criteria

Meets: All subtask deliverables are completed on schedule

Exceeds: Subtask deliverables completed ahead of schedule. Report includes a detailed design of advanced sensors applied to the transition body shape. Physical working example of sensors applied to a representative shape.

2.n Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to the following Bldgs. 1236, 1242, 1247:

1. The Government will provide 1 week of 2 shift testing time in the NTF.
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 and training for NASA LaRC LSTRAC stability analysis code.

4. Other Essential Information:

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.
3. Use approaches described in AIAA 94-2503 and NAS3-27330 Doc. No.: DB-1-026 (Flow Quality Requirements for Laminar Flow Testing)

5. Security Clearance:

Work on classified projects will not be required.

6. Period of Performance:

Planned start date: October 1, 2008 Completion date: September 30, 2009

7. NASA Task Management:

Technical Monitor (Required): Anthony E. Washburn
M/S: 170 Phone: 757-864-1290

Other POC (Optional): Catherine B. McGinley
M/S: 170 Phone: 757-864-5557

TASK ORDER NUMBER: 073D3-NNL09AM01T Revision: 1 Change: 0 Date: December 12, 2008

Title: **Computational Support for Supersonic Cruise Efficiency Research**

1. Purpose, Objective, or Background (Optional):

One of the focal areas in the NASA Fundamental Aerodynamics Supersonics Project is supersonic cruise efficiency. The goal in this area is to develop a better understanding of the flow physics that affect the performance of a supersonic aircraft using computational and experimental studies. This understanding will then be used to develop and apply tools and technologies that will enable the design of efficient aircraft that will also meet other constraints such as low sonic boom levels. In order to address this goal in a timely manner, a computational fluid dynamics (CFD) need has been identified that involves the generation of unstructured CFD grids and flow analysis using the USM3D flow solver.

Two approaches to developing the grids used in the USM3D computations have recently been developed at NASA Langley. These include: a) the AUTOSRC computer code which automatically locates and sizes *line* and *volume* sources used to control grid spacing in the VGRID grid generation code; b) a new *surface* source capability in VGRID that automatically determines grid spacing based on surface curvature. (The latter method is not fully functional at this time but should be available in 2009). The above methods, though automated, have some user-specified input parameters to provide control over the grid generation process. The specific task proposed is the *computational evaluation of grid generation parameter requirements for accurate flow analysis of supersonic vehicles.*

Technical Direction 1 (10/31/08): Updates the initial task order start date to October 30, 2008 as issued by the CO on 10/29/08 (see [TD1] below, Section 6).
Revision 1 (12/12/08): Adds new subtask in section 2 to be done in parallel with original subtask, extends schedule due to delay in obtaining satisfactory geometry and data set for drag prediction study, and extends the period of performance 5 months to 9/30/09 (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Computational evaluation of grid generation parameter requirements for accurate flow analysis of supersonic vehicles.

There is a need to evaluate the level of CFD grid fidelity required in representing supersonic aircraft geometry to ensure accurate performance and sonic boom predictions. To help address the need for accurate performance predictions, the CONTRACTOR SHALL generate up to 50 unstructured CFD grids using the AUTOSRC code with parametric variations of selected input parameters for a NASA-provided configuration. The CONTRACTOR SHALL also generate up to 25 unstructured CFD grids using the new *surface* source capability in VGRID (if available within 3 months of the start of the contract) with parametric variations of selected input parameters for the same configurations. The CONTRACTOR SHALL obtain a viscous flow analysis using the USM3D flow solver for each of the above grids and shall provide summary plots of the variation of up to 6 force and moment coefficients with different values of grid generation input parameters. The CONTRACTOR SHALL also obtain up to a total of 50 additional viscous flow analyses for selected grids at other Mach numbers and/or angles of attack and provide plots of the variation of force and moment coefficients at these conditions. If experimental data is available for the configuration provided, the CONTRACTOR shall include the experimental values for the forces and moments on all plots. To help address the need for accurate sonic boom predictions, the CONTRACTOR SHALL generate up to 50 unstructured CFD grids using the AUTOSRC code with parametric variations of selected input parameters for a NASA-provided configuration. The CONTRACTOR SHALL obtain an inviscid flow analysis using the USM3D flow solver for each of these grids. The CONTRACTOR SHALL provide plots comparing the sonic boom signature with experimental data at up to 5 locations below the configuration for each flow analysis.

The CONTRACTOR SHALL provide the technical monitor with bi-weekly informal updates on progress and problems.

2.1.1 Milestones:

a) Complete grids and performance analyses for AUTOSRC cases by [R1] ***3/31/09***.
b) Complete grids and sonic boom analyses for AUTOSRC cases by [R1] ***6/30/09***.
c) Complete grids and analyses for VGRID cases by [R1] ***9/30/09***.

2.1.2 Deliverables:

a) Summary plots showing the variation of force and moment coefficients from the flow analyses for each parametric series of the grid generation input parameters.
b) Plots showing the variation of force and moment coefficients with Mach number, angle of attack, and/or lift coefficient.
c) Plots showing the comparison of predicted and experimental sonic boom signatures for each parametric series of the grid generation input parameters.
d) Run log including values of grid generation parameters, grid size, force and moment coefficients, convergence levels and run time for each flow analysis.

2.1.3 Performance Metrics/Standard and Schedule:

Minimum acceptable performance (MAP)/Schedule:
a) Complete grids and performance analyses for AUTOSRC cases by [R1] ***3/31/09***.
b) Complete grids and sonic boom analyses for AUTOSRC cases by [R1] ***6/30/09***.
c) Complete grids and analyses for VGRID cases by [R1] ***9/30/09***.

Exceeds performance: Completion of tasks 2 weeks prior to MAP completion date.

*****Begin [R2] block addition*****

2.2 Computational evaluation of grid requirements and analysis process for accurate flow analysis of the plume region on supersonic vehicles

Recent investigation into accurately predicting the flow field and resulting shock structure in the plume region of a supersonic vehicle have shown poor agreement of CFD results with actual flight measured data. Additional flight data has been gathered and further analysis is required to attempt to accurately predict the aft shock region of the flow. In addition, various lift cases have also been flown and comparison to that flight data is required. NASA will provide the required geometry for each flight condition case as well as the surface grids. Experimental conditions and flight measurement data will also be provided by NASA. The CONTRACTOR SHALL use the method described in Task 2.1 or an identified improved methodology for improved capturing of the plume region based on the baseline flight data provided by NASA. The CONTRACTOR SHALL generate up to 50 grids and/or flow solutions to determine the best mesh distribution and computational procedure for capturing all the relevant details for the analysis of the F-15

(#837). The CONTRACTOR SHALL obtain flow solutions at 3 Mach numbers and for 3 fight conditions at each Mach number for a total of 9 flow solutions. GEOLAB support will be provided for any additional identified requirements for geometry and grid changes needed beyond existing supplied grids.

2.2.1 Milestones:

a) Complete study of best practice for predicting aft shock structure in the plume region based on comparisons to baseline flight test data at Mach 1.4 and 1.2. by 3/31/09.
b) Complete grids and analyses for 9 experimental cases by 6/30/09.

2.2.2 Deliverables:

a) Presentation summarizing study results and comparing best practice results to baseline flight test data at Mach 1.4 and Mach 1.2.
b) Plots showing the comparison of predicted and experimental sonic boom signatures for each of the 9 flight test data sets.

2.2.3 Performance Metrics/Standard and Schedule:

Minimum acceptable performance (MAP)/Schedule:

a) Complete best practice study by 3/31/09.
b) Complete grids and analyses for by 6/30/09.

Exceeds performance: Completion of tasks 2 weeks prior to MAP completion date.

*****End R2 block addition*****

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

In the event of episodic on-site LaRC access is required, the Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

For Subtask 2.1, the Government will furnish the geometry for each configuration in VGRID format. The government will also furnish the AUTOSRC code, the TetrUSS software package (VGRID, USM3D), access to advanced supercomputers, aerodynamic data sets, run conditions and specific study objectives.

4. Other Essential Information:

The CONTRACTOR SHALL be proficient in the use of VGRID for generating grids for performance and

sonic boom calculations for supersonic configurations. The CONTRACTOR shall also have experience in running USM3D on supersonic configurations at cruise conditions and be familiar with the extraction and evaluation of sonic boom signatures from the flow solution. Because of restrictions on the access to software and advanced supercomputers, the CONTRACTOR shall be a U.S. citizen.

5. Security Clearance:

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. Period of Performance:

Planned start date: TD1 October 30, 2008 Completion date: R1 ~~April 30, 2009~~ ***September 30, 2009***

7. NASA Task Management:

Technical Monitor: S. Melissa B. Rivers
M/S: 499 Phone: 757-864-5161

Alternate Technical Monitor: Richard L. Campbell
M/S: 499 Phone: 757-864-2872

TASK ORDER NUMBER: 022D2-NNL09AM02T Revision: 0 Change: 0 Date: October 20, 2008

Title: **Support for Orion Relative Navigation DTO.**

1. Purpose, Objective, or Background (Optional)

The Remote Sensing Flight System Branch has the responsibility to support the integration and testing of three sensors (Vision Navigation System, Docking Camera and Star Tracker) and an Avionics Box into the Shuttle for the Orion Relative Navigation DTO (Detailed Test Objective). The objective of this DTO is to validate the suite of sensors that will be use for docking and re-rendezvous for Orion and Constellation. The design of the 3 sensors is the responsibility of Lockheed Martin and NASA Langley Research Center is responsible for the design, fabrication, testing and integration of the Avionics Box.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

2.1 Data System Integration:

1. The Contractor shall provide technical support for the Orion Relative Navigation DTO. This support shall include the generation of drawings, functional testing, integration testing, engineering printed circuit board population, and environmental testing of the flight instrumentation.

2. The Contractor shall provide electrical/electronic fabrication of ground test hardware to support testing of the flight instrumentation for the flight test program. Fabrication procedures will be provided by the flight project.

3. The Contractor shall maintain configuration management for all drawings and hardware

4. The Contractor shall maintain controlled and bonded stores

5. The Contractor shall have current certifications for: printed circuit board soldering for both surface mount and plated through hole, cable crimp and harness fabrication, electro static discharge, and laser safety training

2.1.1 Deliverables and Schedule (Required):

Except for item 4 the following deliverables are ongoing with schedule determined by the program schedule.

1. Configuration Control of all hardware and drawings as specified by the project
2. Drawings and test results
3. Ground Test Hardware
4. Monthly written status reports.

2.1.2 Performance Metrics/Standard (Required - Meets, Exceeds):

Meets:

Timely submission of all deliverables with the following requirements:

1. All drawings conform to ASME-Y14 engineering drawing and related documentation practices and are clear, accurate, and comprehensive, as determined by review and random checks by the TM against actual hardware.
2. 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.
3. Bonded and controlled stores are maintained according to Project's EEE Parts Plan as determined by review and random checks by the TM against the data base.

Exceeds:

Meets and the following requirement:

1. Contractor suggested improvements are accepted (government reviewed and approved) to modify operating procedures or upgrade equipment to improve the design of a system or component.

2.2 Equipment Management:

1. The Contractor shall maintain calibration of all ground support test equipment as per LMS-CP-0506. This requirement will include approximately 20 pieces of equipment located in building 1202. The Contractor may schedule calibration through NASA funded services and facilities.

2. The Contractor shall maintain a chemical database for Orion Relative Navigation DTO in building 1202 utilizing Langley's Chemical Material Tracking System (CMTS) software as per LMS-CP-4759.

2.2.1 Deliverables and Schedule (Required):

The following deliverables are ongoing with schedule determined by applicable LMS documents:

1. Calibrated Test Equipment
2. Configuration management of chemicals

2.1.2 Performance Metrics/Standard (Required - Meets, Exceeds):

Meets:

1. 98% of all test equipment Category One test equipment is calibrated on time
2. All chemicals are tracked in the Chemical Material Tracking System

Exceeds:

1. 100% of all test equipment Category One test equipment is calibrated on time

2.n Working Environment Safety and Organization:

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

1. Lab Facilities at LaRC
2. Specialized printers and plotters
3. Test equipment specific to this task order

4. Other Essential Information:

None

5. Security Clearance:

None

6. Period of Performance:

Planned start date: December 1, 2008 Completion date: October 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Frank Novak

M/S: 468 Phone: 757-864-1862

1. Purpose, Objective, or Background (Optional)

SCOPE

This PWS describes the requirements for the fabrication, verification, and delivery of NASA's Composite Crew Module (CCM) and associated building block test articles. The CCM and building block test articles technology and expertise will support the development of a NASA interagency composite design team. There are three major deliverables from this effort: Mechanical Test Coupons, Sub-Element Test Articles, and Full Scale Composite Crew Module Test Articles. Other than acceptance testing necessary to deliver test coupons/test articles, testing is not part of this work package.

Background

In accordance with applicable data rights clauses, the Government will have Unlimited Rights to technical data developed by the Contractor as part of this effort, and the Government may make such technical data available for future American spacecraft designers, whether those designers are employees of the government, educational institutions or private Contractors.

Program Organization, Responsibilities and Management

The NESC CCM Team has overall program management responsibility for the entire CCM development activity required to design, analyze, fabricate and test all building block sub-elements and the full scale composite crew module. The NESC CCM team is contracting selected activities or tasks such as manufacturing engineering support, tooling design and manufacturing and assembly fabrication tasks. This PWS specifically addresses the manufacture/fabrication of the building block (coupon and sub-element) and full scale CCM test articles.CCM Design and Analysis Team

Designated Contractor CCM Team members will lead and conduct the design and analysis required to fabricate sub-element components and full scale CCM articles. The Design and Analysis (D&A) Team Lead will provide updates to the CCM Team program manager or his designee in monthly reports and by request. The D&A Team will work directly with the Manufacturing Team throughout the design phase to optimize designs for manufacturability and cost.

- Perform design and analysis of CCM components, assemblies and elements in accordance with Government furnished requirements
- Design and control in accordance with Government specified guidelines, software tools and configuration control system
- Provide on-site support as needed during full scale fabrication
- Support design revisions identified during the testing, process development and manufacturing phases of the project
- For all designs, provide applicable models, drawings, stress report, loads report, FE report and a design manual.

CCM Manufacturing Development Team (MDT)

Designated CCM Team members will lead the manufacturing producibility, planning and development efforts required for successful fabrication, assembly inspection and acceptance of building blocks and the full scale CCM. An MDT leader will provide updates to the CCM Team program manager or his designee.

Revision 1 (2/27/09): Clarifies the NOC procedure; updates Table 2.4.5.1; provides additional detail to baseline scope; updates Tables 2.5.1, 2.5.2, and 2.5.3; and revises CCM assembly delivery date to reflect extended manufacturing period of performance (see R1 below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. R1> ***The Government will clarify requirements for each requested subtask activity through NOC's. These requirements will include the specific schedule, expected deliverables (including format), and other clarifications as needed. The Contractor shall include a brief tabulated summary of corresponding activity in the monthly progress reports.*** <R1

In general the Contractor shall provide all site specific resources, supplies, equipment and personnel required to perform fabrication and assembly activities for the sub-elements and full scale CCM hardware. Exceptions to this requirement are specified as Government furnished. The Contractor shall fabricate hardware per Government supplied engineering build packages, specifications and manufacturing plans/work instructions using Government-furnished tooling as defined by NOCs. The Contractor shall provide any fabrication as-built records or documentation to be included in the final acceptance packages for the sub-element test articles or full scale CCM.

2.1: Contractor Coordination and Planning Participation

The Contractor perform the following requirements:

- Provide a fabrication lead or supervisor to act as the primary focal point for managing and coordinating the fabrication activities that occur at the fabrication sites.
- Coordinate with the MDT in reviewing engineering build packages, tooling requirements, and raw materials to identify and recommend any changes that should be incorporated due to site specific requirements, safety, capabilities or experience.
- Coordinate with the MDT in reviewing Government supplied specifications and manufacturing plans/work instructions. Recommend any site specific additions or other changes as required to incorporate or integrate existing practices and procedures for shop operation. If beneficial to improve operational efficiency at specific sites, the Contractor may convert the Government supplied manufacturing plans and work instructions used for hardware fabrication into formats and standards compatible with their internal operations. The Contractor shall provide a copy of converted plans and instructions to the CCM manufacturing team on-site representative for review and approval before starting manufacturing. All requirements, records, and other audit stamps or

signatures shall be complied with. All changes to planning shall be documented and changes that would deviate from the Government furnished plans shall be submitted for review and approval of the on-site CCM manufacturing team representative.

- Arrange for any local orientation or training required for CCM Team members supporting the manufacturing efforts to perform their functions within manufacturing areas (e.g., site safety, FOD, etc.)
- Arrange for CCM Team member site access to provide manufacturing oversight and liaison support during fabrication activities. Provide a guest desk, phone and high speed internet connection for a maximum of two CCM team on-site support personnel, preferably in proximity to the manufacturing work area. For manufacturing work at NASA facilities, NASA will provide this support.
- With advance notification, arrange site access for CCM Team members or other NASA visitors to observe fabrication activities. For manufacturing work at NASA facilities, NASA will provide this support.
- Ensure as-built documentation complies with the configuration management requirements defined by the CCM team.
- Participate with the CCM team in weekly activity coordination/action item meetings
- Provide input to manufacturing readiness reviews that are pertinent to Contractor responsibilities.
- Participate in various CCM Team co-location activities. These co-location activities include but are not limited to PDR, CDR, work sessions, manufacturing development, coordination planning, and review of tooling required for the test articles being fabricated under this PWS.
- Provide manufacturing schedule and cost visibility to the MDT Leader and CCM Team on a weekly basis during active fabrication activities and monthly otherwise.
- Collect labor actuals (hours) and material expenditures for individual sub-elements and full scale CCM hardware for use in future estimates.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required): The Contractor shall perform the above coordination and planning requirements in the time frame documented in NOCs or as master schedule changes are documented in task plan revisions or as mutually agreed upon.

2.1.3 Performance Metrics/Standards: The Contractor will warrant a "meets" rating if all requested products and services are delivered complete and on schedule. The Contractor will warrant an "exceeds" rating if all requested products are delivered ahead of schedule.

2.2: Participation in Tooling Requirements Definition

The Contractor for this CCM fabrication PWS shall participate in defining tooling requirements as follows:

- The Contractor shall participate in tooling reviews. The Contractor shall coordinate early in the program with the Government the need for any tooling or fixtures not included in the initial review of these items proposed by the team.
- The Contractor shall participate in the Government led activities to coordinate requirements with the tooling contractor into the final design for fabrication tooling, assembly fixtures, and handling

fixtures to support fabrication of the composite crew module. Contractor specific responsibilities include, but are not limited to, recommending tooling features or approaches based on Contractor experience and identifying specific interface requirements required for handling or loading hardware into autoclaves or other processing equipment specific to fabrication sites.

- The Contractor shall identify personnel work stands, flat project plates for cure, handling equipment or other items that currently exist at fabrication sites that could be used on a non interference basis during fabrication, cure and assembly activities to help reduce overall program tooling costs.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule: The Contractor shall perform the above tooling requirements definition activity in the time frame documented in NOCs or as master schedule changes are documented in task plan revisions.

2.2.3 Performance Metrics/Standards: The Contractor will warrant a "meets" rating if all requested products and services are delivered complete and on schedule. The Contractor will warrant an "exceeds" rating if all requested products are delivered ahead of schedule.

2.3: Fabrication of Mechanical Test Panels

The Contractor shall fabricate and machine laminate or sandwich mechanical test panels with the specifications listed below. Panels shall be fabricated using processes and cure cycles representative of those planned for the full scale CCM test articles, and consistent with specifications listed in Section 4.

Typical Panel Overall Specifications

- 4' x 4' Flat
- Precured IML
- Combination sandwich and laminate
- NESC to provide fabrication details via the NOC process

In process and final fabrication NDE (nondestructive examination) for composite panels used for mechanical test is the responsibility of the Government.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule: The Contractor shall deliver the panels in the time frame documented in NOCs or as master schedule changes are documented in task plan revisions.

- Test panels (Table 2.3.1)
- As-built fabrication acceptance package documentation for test panels
- Deliver to on-site NASA CCM team representative for testing

Table 2.3.1. Mechanical Test Panels Test Matrix

No.	Panel Test	Property	Qty
1	Sandwich	bondline tensile strength	4
2	Sandwich	in-plane compressive strength	
3	Sandwich	in-plane compressive strength	2
4	Laminate	residual strength	2
5	Laminate	laminate bearing strength	2

2.3.3 Performance Metrics/Standards: 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 ahead of schedule.

2.4: Sub-Element Fabrication Effort

The sub-element fabrication activity includes composites fabrication, procurement, assembly of metallic details and any final machining or finishing required to supply finished sub-elements, ready for gage installation, installation of test fixtures and testing by the CCM team.

The Government will provide all expendable materials for composites activities associated with the sub-element fabrication activities performed at MSFC/NCAM. The Government will provide in process and final fabrication or assembly NDE for sub-elements. As specified in NOCs, the Contractor's facility may be used for any sub-element or other test panel fabrication. Additionally, the Contractor shall make fabrication materials purchased under this contract available to support sub-element and test panel fabrication per Government specifications via the NOC process.

After fabrication of individual sub-element test articles is completed, the materials certifications, build documentation, Material Review Board (MRB) actions, and NDE records will be provided to the government for review prior to final acceptance. Original copies of all as-built and fabrication documentation including Contractor generated or modified documents shall be provided to the CCM team as part of the acceptance package. In accordance with Section 4, the Contractor shall package and ship the test elements to NASA per NESC Team instructions.

2.4.1: Belly Band Splice Element Test Article

The Contractor shall perform fabrication, assembly, and final machining of the belly band splice joint test articles, representative of the belly band splice joint of the CCM plus one each (three total) NDE standards. Three panels representing three construction variations will be fabricated (each containing six test specimens and one NDE standard) using materials and processes similar to the full scale CCM fabrication as listed in

Table 2.4.1.1. The basic construction for these elements is shown in figure 2.4.1.1. The acreage area splice joint represents the ideal configuration typical of a majority of the splice area. The acreage with joint offset will be representative of the acreage joint with localized corrective action for a mismatch between the upper and lower shell structures (locally sand mismatch or small local ply buildup).

The longeron area splice is representative of locally built up areas of the joint where higher loads are introduced by the SM/ALAS longerons. All configurations include co-bonded splices on both sides of precured full-depth sandwich structures.

In addition to fabricating the test articles listed in Table 2.4.1.1, the splice panels shall be large enough to fabricate an NDE standard for each configuration to facilitate the inspection of these test articles, consistent with CCM-Spec-006.

Deliverables:

- 24 Test articles (Table 2.4.1.1)
- Three NDE Standards, one for each configuration
- As-built fabrication acceptance package documentation for Belly Band Splice Joint Test Articles

Table 2.4.1.1. Belly Band Splice Element Specimens

Drawing #	Specimen Name	Approx. Size	Qty	NDE Standard
1247820	Splice Acreage Area	24" x 3"	6	1
1247821	Splice Longeron Area	24" x 3"	12	1
1247822	Splice Longeron Area w/joint offset	24" x 3"	6	1

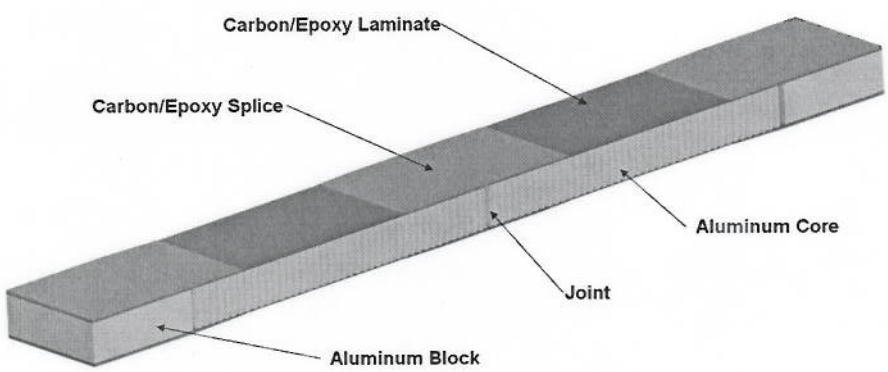


Figure 2.4.1.1. Belly Band Splice Element Specimen

2.4.2: Service Module/Alternate Launch Abort System (SM/ALAS) Element Test Article

The Contractor shall perform fabrication, assembly, and final machining of the three SM/ALAS sub-element test articles. These test articles shall be representative of the SM/ALAS element of the CCM. Figure 2.4.2.1 shows the configuration of the SM/ALAS attach fitting test article. The barrel section, backbone structure, and SM/ALAS fitting attach longerons are all precured composite details. The barrel section design may include a precured laminate hat shaped detail the same thickness as the core that is used for mechanical fastening of the backbone and the longerons. The backbone structure is bonded to the lower barrel section using pi (π) preforms. Metallic fittings are mechanically attached. The GFE lay-up tool is expected to accommodate fabrication of at least two specimens at once, and is single curvature, not a cylindrical cutout. Metallic detail fittings and pi pre-forms are GFE provided.

In addition to fabricating the test articles listed in Table 2.4.2.1, the Contractor shall fabricate a simplified NDE standard to facilitate the inspection of these test articles, consistent with CCM-Spec-006. The NDE test standard configuration shall only include composite details for the tank wall structure with any internal sandwich details required for attachment of the metallic fitting as well as representative backbone structure bonded with pi preforms.

Deliverables:

- Test articles (Table 2.4.2.1)
- One NDE Standard
- As-built fabrication acceptance package documentation for SM/ALAS Element Test Articles.

Table 2.4.2.1. SM/ALAS Element Specimens

Drawing #	Specimen Name	Approx. Size	Qty	NDE Standard
1247895-001	SM/ALAS Test Article-Flat	44" x 50"	3	1

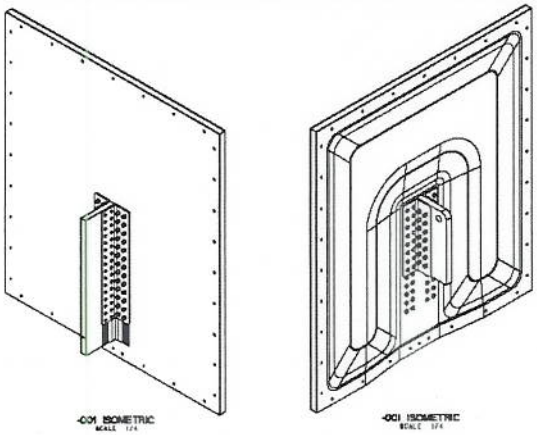


Figure 2.4.2.1. SM/ALAS Element Test Article

2.4.3: Backbone Lobe Test Article

The Contractor shall perform fabrication, assembly, and final machining of six-each (24 total) Backbone Lobe test articles, which is representative of the Backbone Lobe of the CCM. Test specimens shall be cut from three separate element panel construction configurations (flat base, sandwich base, and 20 degree base), fabricated using materials and processes similar to the full scale CCM fabrication. The proposed flat base and 20 degree base panel configurations are shown in figure 2.4.2.1. The flat pull and flat sandwich coupons referred to in table 2.4.3.1 are the same except the base is a sandwich structure (not shown) instead of a laminate. The Flat Shear coupons are made from the flat laminate base panels and cut to a different length. Pi pre-forms are GFE provided.

In addition to fabricating the test articles listed in Table 2.4.3.1, the Contractor will fabricate three NDE standard (one each for flat base, sandwich base and 20 degree base configurations) to facilitate the inspection of these test articles, consistent with CCM-Spec-006. The elements made for each of the three configurations shall be long enough to include an area to be cut off for each NDE standard.

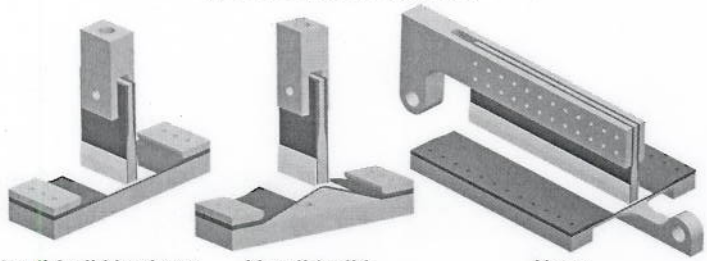
Deliverables:

- 24 Test articles (Table 2.4.3.1)
- Three NDE Standards, one for each configuration
- As-built fabrication acceptance package documentation Backbone Lobe Test Articles

Table 2.4.3.1. Backbone Lobe Test Specimens

Drawing #	Specimen Name	Approx. Size	Qty	NDE Standard
1247831-001	Flat Pull - Solid Laminate	12" x 3"	6	1
1247836-001	Flat Pull - Sandwich	12" x 3"	6	1
1247832-001	20 Degree Pull	12" x 3"	6	1
1247831-003	Flat Shear - Sandwich	12" x 12"	6	

Typical Backbone Test Specimens
(Test hardware not included)



Flat pull (solid laminate and sandwich) 20 pull (solid laminate) Shear

Figure 2.4.3.1. Backbone Test Specimens

2.4.4: LIDS Ring to Tunnel Interface Test Article

The Contractor shall perform fabrication, assembly, and final machining of the six LIDS Ring to Tunnel Interface test elements, which represent the LIDS Ring to Tunnel Interface of the CCM. The LIDS ring to tunnel interface test elements consist of solid laminate bonded to a metallic detail representative of the LIDS ring. Metallic detail representing the LIDS is GFE provided.

In addition to fabricating the test articles listed in Table 2.4.4.1, the Contractor will fabricate one NDE standard to facilitate the inspection of these test articles, consistent with CCM-Spec-006. The elements made shall be long enough to include an area to be cut off for the NDE standard.

Deliverables:

- Six test articles (Table 2.4.4.1)
- One NDE Standard
- As-built fabrication acceptance package documentation LIDS Ring to Tunnel Interface Test Articles

Table 2.4.4.1. LIDS Attach Interface Test Specimens

Drawing #	Specimen Name	Approx. Size	Qty	NDE Standard
1247815-001	LIDS Ring to Tunnel	14" x 3"	6	1

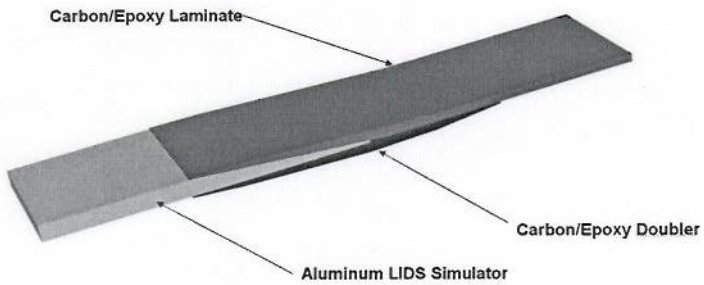


Figure 2.4.4.1. LIDS Ring to Tunnel Interface Test Article

2.4.5: Design Verification Test Panels

Contractor shall support fabrication of the test panels described in Table 2.4.5.1 with materials, labor and facility. Materials shall be base-lined into the full scale article procurement plan. Fabrication shall be conducted at the MSFC/NCAM facility or at the Contractor's facility, as specified by the NOC process.

Table 2.4.5.1. Design Verification Test Panels

Quantities to be communicated to the Contractor via the NOC process.

Drawing No.	Description	Qty
R1 ***Sketch (.ppt)***	Test Panel, T-Insert	R1 ***3***
R1 ***Sketch (.ppt)***	Test Panel, Core Ramp	R1 ***1***
R1 ***Sketch (.ppt)***	Test Panel, Cruciform	R1 ***1***
R1 ***Sketch (.ppt)***	Test Panel, Permeability	R1 ***3***

2.4.6.1 Milestones (Optional):

2.4.6.2 Deliverables and Schedule (Required): The Contractor shall deliver work products (defined in subsections 2.4.1-5) in accordance with the master schedule or the time frame documented in NOCs.

2.4.6.3 Performance Metrics/Standards: 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 ahead of schedule.

2.5: Full-scale Composite Crew Module Fabrication Effort

The Contractor shall fabricate three full scale CCM test articles in accordance with the Government provided design/layout drawings of the Full-scale Composite Crew Module. The primary full scale test article objectives are: 1) Upper Pressure Shell Assembly Manufacturing Demonstration Article (1248200-003, Deviation 01 R1> ***and subsequent design modifications*** <R1), 2) Upper Pressure Shell Test Article (1248200-001), 3) Lower Pressure Shell Test Article (1248400-001), 4) CCM Assembly (1248010) comprised of items 2) and 3), and R1> ***5) CCM Primary Structure Assembly (1248005) comprised of item 4) and 1248600, 1248610, 1248620 and 1248630 cover assemblies.*** <R1

All special tooling and equipment shall be government or Contractor furnished as specified in Table 2.5.1 and shall be government owned. All non-special tooling and equipment shall be Contractor furnished.

Table 2.5.1. Full Scale Article Special Tooling

Assy	Part No.	Description	Supplier
Common	C011T305-001	Finished Case Shipping Container, UPS	Contractor
	R1> ~~***C011T306-001***~~	~~***Finished Case Shipping Container - CCM Assy***~~	~~***Contractor***~~ <R1
	C011T202-001	Splice Assembly Cure Cart	Contractor
	R1> ~~***C011T106-001***~~	~~***Belly Band***~~	~~***Contractor***~~ <R1
	MSA CCM010	Splice Joint Heating System	Contractor
	6434-07	EOP Trim Saw, Upper/Lower	Government
	6434-06	HALO Handling Fixture	Government

	6018-18-03	Upper/Lower Pressure Shell Cure Cart	Government
	R1> ***124XXXX***	***Test Fixture, CCM Assembly***	***Contractor*** <R1
Lower Pressure Shell	C011T302-001	Lift Fixture, Backbone	Contractor
	C011T201-001	Trim Fixture, Waterjet, Backbone Cap	Contractor
	C011T108-001	External Faux SM/ALAS Fittings	Contractor
	C011T101-001	Brackets, Backbone Bonding, Faux SM/ALAS	Contractor
	MSA CCM009	Rotamold for Backbone	Contractor
	R1> ~~***MSA CCMXXX***~~	~~***Backbone Panel Assy Tooling, Woven Cruciform***~~	~~***Contractor***~~ <R1
	6434-08-02	Drill Plate Set,Universal	Government
	6434-08-01	Drill Plate Set, Planar	Government
	R1> ~~***6434-XX***~~	~~***Backbone Cap Mold Plate, Cruciform Pins***~~	~~***Government***~~ <R1
	R1> ***6434-17***	***Plate, Backbone Panel Assembly***	***Government*** <R1
	R1> ***6434-17***	***Cruciform Pins, Backbone Panel Assembly***	***Contractor*** <R1
	6434-16	Lower Shell Work Floor	Government
	6434-15	SM/ALAS Wing Drill Fixture	Government
	R1> ~~***6434-14***~~	~~***Angle Plates for Curing of Backbone Structure***~~	~~***Government***~~ <R1
	6434-13-04	Backbone Pi Drill Fixture	Government
	6434-13-03	SM/ALAS Fitting Drill Fixture	Government
	6434-13-02	SM/ALAS Drill Fixture	Government
	6434-13-01	Backbone Cap Table Stands	Government
	R1> ~~***6434-02***~~	~~***SM/ALAS Wing Mold***~~	~~***Government***~~ <R1
	6434-01	Backbone Cap Mold Plate	Government
	6018-21-01	Lower Pressure Shell Mandrel	Government
	6018-18-02	Lower Pressure Shell Steel Support Dolly	Government
Upper Pressure Shell	C011T207-001	Drill Fixture - Upper Shell, Gusset Cap	Contractor
	C011T107-001	Alignment Tool - Upper Shell, LIDS Ring Bonding	Contractor
	C011T102-001	Alignment/Bond Fixture - Upper Shell, Gusset	Contractor
	C011T002-001	Rubber Intensifier Molds	Contractor
	MSA CCM011	Parachute Fitting Internal Mylar	Contractor
	MSA CCM008	Rotamold for Gusset	Contractor
	MSA CCM006	Internal Parachute Fitting Drill Fixture	Contractor
	MSA CCM001	External Parachute Fitting Drill Fixture	Contractor
	6434-11	Hatch Routing Template	Government
	6434-10-02	Horizon Window Routing Template, Right	Government
	6434-10	Horizon Window Routing Template, Left	Government
	6434-09-02	Docking Window Routing Template, Right	Government
	6434-09-01	Docking Window Routing Template, Left	Government
	6434-03	LIDS Ring Doubler Mold	Government
	6018-18-01	Upper Pressure Shell Steel Support Dolly	Government

	6018-14-01	Upper Pressure Shell Insert	Government
	6018-11-01	Upper Pressure Shell Mandrel	Government

The MDT will provide specification, manufacturing plans and clarifications to the Contractor to support fabrication and assembly efforts for the full scale CCM. The Contractor will have input into these documents. The MDT will also have manufacturing approval responsibility during the full scale CCM manufacturing activity. Government provided details will be provided to the customer via the NOC process.

All end item material shall be Contractor furnished except those listed in Table 2.5.2. Any additional design requirements for non-destructive inspection and coatings shall be implemented by the Contractor. Contractor long lead material procurement requirements are identified in Table 2.5.3.

Table 2.5.2. Government Furnished End Item Material

PN		Qty	Description
Upper Pressure Shell	*1248145*	*1*	*Hatch Frame, Main Hatch*
	1248147	*2*	*Window Frame, Side*
	1248151-001	*1*	*Window Frame, Docking, Port*
	1248151-002	*1*	*Window Frame, Docking, Starboard*
Lower Pressure Shell	R1> ~~*1248501-001*~~	~~*2*~~	~~***SM/ALAS Fitting, External, Straight***~~
	~~*1248502-001*~~	~~*2*~~	~~***Backbone Fitting, Lower Straight***~~
	~~*1248502-002*~~	~~*2*~~	~~***Backbone Fitting, Lower Straight***~~
	~~*1248503-003*~~	~~*2*~~	~~***Backbone Fitting, Upper Straight***~~ <R1
	TEST	*7*	*Cruciform, Metal, 2 Inch*
	R1 ***1248430***	A/R	*Cruciform, Woven*

Table 2.5.3. Long Lead Materials (Quantities for procurement purposes only)

Material	Details/Specification	Units	Amt.
IM7/977-2, Prepreg Fabric	CCM-SPEC-001, Type II	lbs	3000
IM7/977-2, Prepreg Uni Tape	CCM-SPEC-001, Type I	lbs	500
Honeycomb Core	5052 or 5056/F40, 4.4 lb/ft3	sqft	Per dwg
Honeycomb Core	5052 or 5056/F40, 6.9 lb/ft3	sqft	Per dwg
Honeycomb Core	5052 or 5056/F40, 5.7 lb/ft3	sqft	Per dwg
Honeycomb Core	5052 or 5056/F40, 8.1 lb/ft3	sqft	Per dwg

neycomb Core	5052 or 5056/F40, 12.0 lb/ft3	sqft	Per dwg
I300K, Adhesive Film	.08 lbs/sqft	sqft	1300
I300M, Adhesive Film	.05 lbs/sqft	sqft	R1 ***3000***
Preform	BRM-7132 (0.18 wide)	Ft	50
Preform	BRM-7136 (1.084 wide)	Ft	400
I410-1 Foaming Adhesive	P/N 70416300 0.10 thick	sqft	72
3010, Potting Compound	6-oz Semco Cartridge	ea	200

ull scale CCM fabrication activity includes fabrication, bond and mechanical assembly, and any final ining or finishing required to supply finished full scale CCM structure ready for the test team to install imulated internal loads, opening closeouts and gages for testing. Note: some internal loads may require lation prior to completing the belly band joint. Concurrence from the MDT is required prior to belly closeout. The Contractor is responsible for all NDE inspection requirements on the full scale test es.

ive engineering and quality acceptance for individual parts, sub-assemblies, major assemblies, and final nbly will be required through the course of fabrication, culminating with Government acceptance of the CM. The materials certifications, material out time records, engineering build packages, as built mentation and fabrication audit trails, cure records, MRB actions, and NDE records will be compiled eviewed by the CCM team for acceptance of the Contractor fabricated and assembled CCM structure. nal copies of all as built and fabrication documentation including Contractor generated or modified ments will be provided to the CCM team as part of the acceptance package. The contractor shall graphically document the fabrication throughout the process.

Contractor shall adequately protect, and package where appropriate, the in-process and the full-scale to ensure they are not damaged during all moves, for transportation between fabrication areas or sites, or shipping for test.

Contractor shall package and ship the full scale CCM to NASA for testing per NESC Team instructions cordance with Section 4.0. (A preliminary weight estimate for the structure is 1000 lbs.) All other rnment property shall be shipped to NASA MSFC at the end of the contract.

2.5.1 Milestones (Optional):

2.5.2 Deliverables and Schedule (Required): The Contractor shall deliver work products in the time frame documented in NOCs.

2.5.3 Performance Metrics/Standards: 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 ahead of schedule.

Manufacturing and Quality Planning

Contractor shall assist NASA and the MDT in review of the composite crew module design/layout,

process specifications, and manufacturing plans with particular emphasis on interfaces to site specific equipment or capabilities and on progressive NDE through the build and assembly process. Based on NASA supplied designs and participation in manufacturing planning activities and reviews the Contractor shall develop a quality assurance plan based on current capabilities and quality processes. This plan shall support the system requirements for product compliance verification and material review. The quality plan shall allow methods for NDE of each component in accordance with CCM-SPEC-006 to be conducted and certified by the Contractor (for methods within the Contractors capability) or by the government (for other methods designated). Deviations to the Contractor's standard quality processes or procedures will be defined by the NESC Team and documented in the quality plan or program plan, as applicable. The quality plan shall ensure that individual parts and sub-assemblies meet engineering requirements prior to final (permanent) installation in a next assembly based on NDE analysis, completion of build-package documentation, and resolution of any MRB actions. Any exceptions shall require approval by the CCM engineering liaison representative. The plan will be provided to the CCM Team for review and approval. Previously fabricated NDE standards will be provided during the full scale CCM fabrication efforts to aid in the NDE analysis. The Contractor will work with the MDT to incorporate appropriate NDE steps into the manufacturing planning/work instructions used on the shop floor.

2.6.1: Manufacturing Readiness Review (MRR)

Manufacturing readiness reviews will be led by the MDT.

The Contractor shall support the MDT and provide input associated with their areas of responsibility for creation, participation, presentation and review of materials for an MRR to the NASA CCM team to receive authorization to initiate the full-scale composite crew module test article (1248010) fabrication. There will be an initial overall review, with periodic updates for major structures or assemblies as the engineering build packages, planning, tooling and other items required for manufacturing are matured.

2.6.2: Composite Crew Module Fabrication

The Contractor shall provide labor and all other resources not specified as Government-furnished to fabricate and assemble the full-scale composite crew module. The composite crew module consists of major assemblies for the upper and lower shells with sandwich stiffened structures with local reinforcement as required, load attach fittings (provided by the CCM Team) and other miscellaneous hardware. The construction details of these assemblies are consistent with building block test articles and figures discussed in section 2.4 of this document. The upper and lower shells mate together with a bonded belly band splice joint resulting in the completed structural assembly. Full scale CCM fabrication activities include the following progression.

A manufacturing demonstration article shall be fabricated for upper shell with the full shell sandwich construction. This shell shall be used for further analysis of potential manufacturing problems associated with fabrication prior to fabrication of the full test article.

A full scale CCM test structure shall be fabricated, assembled, inspected, accepted and delivered for test.

2.6.3: Future Activity Planning

The Contractor shall collect labor actuals and material costs for details and assemblies through the course of fabrication activities. The Contractor shall provide a forecast for Contractor costs if additional replicates of the CCM are desired at a future date. The Contractor shall identify separately the Contractor procurement costs if future articles include responsibility for Contractor supplied materials. The Government will provide the material quantities and supplier costs associated with the first article to aid in this effort.

2.6.4.1 Milestones (Optional):

2.6.4.2 Deliverables and Schedule (Required): The Contractor shall deliver work products in the time frame documented in NOCs. All deliverables, including, but not limited to data, documentation, drawings and hardware will become the property of NASA, to be used to further the capability of the United States in developing future spacecraft. Deliverables for test coupons and sub-elements are listed in Section 2. A Hardware Assessment Review will be conducted in accordance with CCM-PLAN-001 immediately prior to shipment of full scale hardware deliverables.

Full scale and other deliverables applicable to this PWS are as follows:

- Product design (electronic), to include the following (Due [R1]~~Feb 28,~~ 2009 ***April 30, 2009***)
  - Design Manual
  - Drawings
  - CAD Models
  - FE Models & Report
  - Stress Report
  - Loads Report
- All full scale development and test articles defined in Section 3.4 (DD250) (Due [R1>]~~Feb 28, 2009 if material in stock as of Oct 1, 2008 is sufficient to complete scope; otherwise due Mar 31,~~ 2009 ***April 30, 2009***[<R1])
- Addendum to Contractor's existing quality plan identifying items unique to performance of this PWS as defined in 3.4.1 (Due at full scale article HAR)
- Provide manufacturing schedule and cost visibility to the MDT Leader and CCM Team on a weekly basis during active fabrication activities and monthly otherwise
- Collect labor actuals (hours) for individual sub-elements and full scale CCM hardware for use in future estimates and Monthly Financial Report for this task order (Due at full scale article HAR)
- Progressive fabrication photos with a minimum resolution of 300 pixels per inch (Due at full scale article HAR)
- As-built fabrication acceptance package documentation for full scale development and test articles (Due at full scale article HAR)
- Test panels, sub-elements and associated documentation as defined in Sections 3.2 & 3.3 (Due on or before full scale article HAR)
- Project Final Report Draft - Technical input and support (Due Jul 15, 2009)

Schedule

The Contractor shall plan fabrication and delivery in accordance with a master schedule. The master schedule for full scale fabrication shall be developed and maintained by the Contractor and shall define a

critical path that delivers full scale test hardware in accordance with Section 2.6.2. The Contractor shall coordinate the integrated production schedule with the NESC Team, to include, at a minimum, weekly updates, support requirements, schedules risks, and risk mitigation.

2.6.4.3 Performance Metrics/Standards: 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 ahead of schedule.

2.7: Program Management: Reviews, Meetings and Special Tasks

The Contractor shall support teleconference and in-house review efforts by the Government. The Government reserves the right to review and approve the manufacturing planning and fabrication process performed by the Contractor. The Contractor shall support the Manufacturing Readiness Reviews (MRR) to ensure that there is adequate time to review and approve the information without schedule impact. The Government shall not require more than three working days of MMR review/approval time to authorize the Contractor to proceed with the planned activities. The following MMR activities will be performed.

a. Manufacturing planning is 50% complete.
b. Sub-element manufacturing planning complete, ready to start fabrication of sub-element test articles.
c. Composite Crew Module manufacturing planning complete, ready to start fabrication of CCM test article.

2.n: Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Major tooling, design specifications, drawings and certain metallic fittings will be provided to the manufacturing/fabrication Contractor as Government Furnished Equipment (GFE) as defined in this PWS.

The NESC CCM Team has direct responsibility to provide personnel and resources for the following tasks, activities or resources.

- Program oversight and management
- Engineering build requirements/packages (design/layout drawings, material and processing

specifications, bill of materials, assembly interfaces, inspection acceptance criteria)

- Materials Specification Document (MSD). The MSD will include raw material description, storage, tracking/marking, quality receiving inspection, and shipping requirements for composite and adhesives.

- Provide all raw materials (e.g., prepreg carbon cloth, honey comb core, adhesive, etc.) required for fabrication of building block test elements and test panels. Upon receipt of sufficient inventories of raw materials, as defined herein, the Contractor shall assume responsibility to supply raw materials for test elements and panels required to supplement material supplies provided by the government.

- Design and provide unique sub-element and CCM tooling required for composite fabrication and assembly operations as defined herein. This does not include local tooling aides or standard tooling which are typically the responsibility of the Contractor.

- Liaison engineering for fabrication activities including MRB review and disposition required during fabrication efforts.

- Establish and maintain a configuration management plan which will describe the process used to establish the baseline design, incorporate and track design changes, and document the as-built configuration of tooling and CCM test articles.

4. Other Essential Information:

Information to Be Provided With and On Contractor Data Deliverables

All data deliverables shall be accompanied with a Data Shipper Transmittal/Review and Disposition Form, provided by the Government and delivered to the Contracting Officer.

The Contractor shall provide a non-repeating transmittal number on the form for reference purposes.

Deliverable data shall have a document number, shall be dated, pages shall be numbered, and shall reference the P/N and S/N spell out where applicable. When applicable, deliverable data shall show revision status and shall have a revision page.

Identification, Packaging and Shipping

The Contractor shall be responsible for packaging and shipping deliverable hardware such that performance, life, and cleanliness are not degraded. The test articles and CCM shall be delivered to the NESC CCM Team in an enclosed shipping container protected from the elements of nature. The test articles and CCM shall be in a ready-to-use state free of contaminants that may cause part lamination problems. Parts shall be marked with engineering numbers and as specified in manufacturing plans.

The shipping container shall be durable and legibly marked with shipping information furnished by the NESC CCM Team.

All deliverable hardware shall be shipped to NASA for testing per NESC Team instructions. For estimating purposes use the address below unless stated otherwise in this PWS.

NASA/Langley Research Center
Building 1293A
Hampton, VA 23681-2199

Applicable / Reference Documents

The following documents are applicable to this PWS and attached appendices to the extent specified herein. In the event of conflict between the requirements of this PWS and any referenced documents, the requirements of this PWS shall govern.

Military Standards

N/A

Specifications

Specification No.	Description
543-SPEC-003	Process Requirements for Application of BR127 Primer
CCM-SPEC-001	Material Specification, Preimpregnated Carbon Fiber Reinforced Resin Tape and Fabric
CCM-SPEC-002	Process Requirements for Carbon Fiber Reinforced Epoxy Laminates, 350°F Curing
CCM-SPEC-003	Process Specification for Fabrication of Composite Sandwich Structure, 350°F Curing
CCM-SPEC-006	Non-Destructive Examination Test Requirements and Defect Acceptance Criteria for Nonmetallic Materials
P-442-2983	SLIC Program Requirements for Fastener Installation
P-442-2984	SLIC Program Requirements for Machining, Drilling and Trimming of Composite Structures

Documents

CCM-PLN-001 CCM Quality Assurance Plan

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): This task was evaluated for organizational conflict of interest (OCI) in accordance with modification 1 of the TEAMS contract. It was concluded that no OCI exists.

6. Period of Performance:

Planned start date: 12/1/08 Completion date: 9/30/09

7. NASA Task Management:

Technical Monitor:	**Diana Kerns**	M/S: 105	Phone: 757.864.8473
Technical POC:	**Mike Kirsch**	M/S: 116	Phone: 757.864.4135

TASK ORDER NUMBER: 003E1-NNL09AM04T Revision: 0 Change: 0 Date: February 2, 2009

Title: Technical and Business Management Support for External Agreements

1. Purpose, Objective, or Background (Optional)

The focus of this task is to provide external technical and business management services for facilitating the establishment of external agreements between NASA programs, researchers, and external customers. This support will also provide the management oversight support services for the execution of these agreements in coordination with NASA Project managers, Aeronautics Research Directorate, APPO, Line management, and researchers involved in the execution of these agreements. This support must have technical knowledge and skills necessary to develop reimbursable project requirements and plans in support of the ARD Mission. A thorough knowledge of Langley's facilities and capabilities is essential to this task as is a technical working knowledge of all disciplines at the center. Further, a thorough knowledge of the organizations, culture, and processes at Langley for conducting reimbursable activities is required. A technical background in aerospace research & development is essential with at least 15 years of R&D project management experience is desired.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Work description for Project Manager for Fully and Cooperatively Reimbursed Projects

a) The Contractor shall provide business management and project execution oversight support services to the Aeronautics Research Directorate in the establishment and management of external agreements for projects.

b) The Contractor shall coordinate the development of project plans including technical scope, definition of technical requirements and execution plans by working closely with the NASA Technical Points of Contact, ARD/ARMD project staff, APPO, and line managers.

c) The Contractor shall coordinate the development of the agreement together with the NASA Technical Point of Contact, ARD management, ARMD project management staff, and with APPO to ensure external customer inputs are obtained.

d) The Contractor shall ensure the agreement is processed and approved through the appropriate NASA officials and with APPO to ensure external customer inputs are provided.

e) The Contractor shall provide project management oversight support services for the execution of these external agreements and identify any issues that need resolution by ARD management or NASA Project leads.

f) The Contractor shall work closely with the support being provided under task #NNl07AM49T to ensure all resources are being managed appropriately in support of ARD sponsored external/reimbursable projects and activities.

g) The Contractor shall provide process improvement recommendations to the NASA Technical Monitor.

2.1.1 Milestones (Optional):

-Develop a Reimbursable Projects Master Schedule by end of June 09

-Conduct the first semi-annual reimbursable projects review by the end of August 09

2.1.2 Deliverables and Schedule (Required):

a) A report of new ARD external business/reimbursable projects established for the month including projections by quarter for the upcoming year. – Monthly

b) A report on any discussions and /or issues that were resolved pertaining to reimbursable project execution along with overall status of all ongoing reimbursable projects – Quarterly

c) Meetings with the NASA TM and/or other NASA managers to discuss ideas for needed improvements. The meetings will also provide a forum for describing the status of new and existing external business and direct project resources. – Quarterly

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Minimum acceptable level:

(a) Reports summarizing ARD external business activities submitted monthly.
(b) Reports summarizing project status and resolved issues quarterly or as requested.
(c) Quarterly meetings with the task monitor or other designated NASA manager to discuss proposed improvements and progress on current improvements.

Exceeding minimum acceptable level:

(a) A report summarizing ARD external business activities submitted monthly.
(b) Reports summarizing project status and resolved issues to the NASA Technical Monitor by the 10th of each month.
(c) Monthly meetings with the task monitor or other designated NASA manager to discuss proposed improvements and progress on current improvements.

2.2 Sub-Task - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.2.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.2.2 Required date: Ongoing.

2.2.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: N/A

4. Other Essential Information: N/A

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): ITAR and Company proprietary information

6. Period of Performance:

Planned start date: April. 1, 2009 Completion date: Mar 31, 2010

7. NASA Task Management:

Technical Monitor (Required): Vincent Schultz
M/S: 264 Phone: 864-5184

Alternate Technical Monitor: Jim Burley
M/S: 254 Phone: 864-2008

TASK ORDER NUMBER: 023D2-NNL09AM05T Revision: 1 Change: 0 Date: April 1, 2009

Title: Electronic Engineering Support for the Constellation (Cx) Program

1. Purpose, Objective, or Background (Optional)

This effort will provide electronic support for the Electronic Systems Branch to the Avionics Leads for the Constellation Program and the project Principal Investigator for the ALHAT Project.
Technical Direction 1 (12/2/08): Updates the initial task order start date to December 1, 2008 and the completion date to October 31, 2009 as issued by the CO on 11/24/08 (see [TD1] below, Section 6).
Revision 1 (4/1/09): Deletes LSS and ALHAT subtasks (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

2.1 Constellation Project Avionics Lead Support

1. The Contractor shall participate in Constellation and Level III Project milestone reviews (design assessment, document review, Review Item Discrepancy (RID) initiation and follow-up).

2 The Contractor shall support the Constellation avionics studies and efforts. This support includes The Integrated Design and Analysis Cycles (IDACs), common standards development, Technical Interchange Meetings (TIMS) and standing meeting representation/support.

2.1.1. Milestones:

There are no specific milestones under this task.

2.1.2 Deliverables and Schedule (NOC):

Reports, test plans, schedules, system-level and subsystem designs of flight systems, hardware trade studies requested by the Avionics Lead shall be delivered electronically to the TM within two weeks after the completion of the activity identified in the NOCs.

2.1.3 Performance Metrics/Standards Meets/Exceeds:

Meets Requirements will be defined as delivery by due date of reports/drawings/schedules/test plans/designs/hardware trade studies requested by the Avionics Lead. Exceeds Requirements will be defined as delivery of said items one week or more prior to due date.

2.2 Lunar Surface System Avionics Lead Support [R1] ***Deleted***

2.3 Project ALHAT Avionics Lead Support [R1] ***Deleted***

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and

organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

1. Lab Facilities at LaRC
2. Specialized printers and plotters
3. Test equipment specific to this task order

4. Other Essential Information: None

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

No security clearance required.

Note: This activity requires the use of sensitive and ITAR controlled information. A Non-disclosure Agreement (NDA) shall be executed and kept on file. The person supporting this task shall be qualified to handle ITAR controlled information. All sensitive and ITAR controlled information shall be managed in accordance with NASA policy.

6. Period of Performance:

Planned start date: [TD1]December 1, 2008 Completion date: [TD1]October 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Marvin Beatty

M/S:488 Phone:757.864.1689

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 005C1-NNL09AM06T Revision: 0 Change: 0 Date: November 5, 2008

Title: **Project Coordination and Document Preparation support for NESC**

1. Purpose, Objective, or Background (The work described below in Section 2 was previously performed under task order 001C1-NNL07AM00T.)

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 is comprised of the best engineering expertise from across the Agency and includes 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, a 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 lasts about 4-6 months. In some cases an assessment may last a year or more. Each 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 fifteen established Super Problem Resolution Teams (SPRTs). Each SPRT is led by an NESC Discipline Expert (NDE) and provides a pool of technical expertise to the NESC in general and to assessment teams as assessments are planned and conducted. The SPRTs currently supply expertise in the following disciplines: Guidance, Navigation and Control; Non-Destructive Evaluation; Propulsion; Power and Avionics; Mechanical Analysis; Flight Sciences; Mechanical Systems; Human Factors; Materials; Structures; Fluids/Life Support/Thermal; Software; Manned Flight Operations; Robotic Missions; and Systems Engineering. The SPRTs hold frequent teleconferences and may conduct periodic face-to-face meetings.

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 activity 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). The NCEs acts as conduits 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.

The purpose of this task order is to provide project coordination (Project Planning and Communication) and document preparation (including document configuration control) support for the NESC's assessment teams, SPRTs, the Deputy Director for Safety and NCEs.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)
Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. The Contractor shall include a brief tabulated summary of responding activity in the monthly progress reports. See NOC designated item(s) and description below.

2.1 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 assessment teams and SPRTs, including the Deputy Director for Safety and the NCEs. The Contractor shall complete tasks involving 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 various NESC teams throughout the planning and conduct of 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.

Deliverables and Schedule: The Contractor shall deliver newly developed or updated project schedules and standard analytical reports in the time frame documented in NOCs and approved by the appropriate team lead. If not established by NOC, 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 assessment or SPRT investigation, as well as a continuing familiarity with the assessment 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 assessment (or SPRT investigation).

2.2 Project Communication: The Contractor shall provide administrative support for assessment and SPRT meetings, which will be conducted as teleconferences or face-to-face, 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, presentations, plans and reports, 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 associated documentation. As part of this project communication effort, Contractor personnel shall also coordinate the delivery of associated service covered in 2.2 Project Coordination and Planning and in 2.4 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.

2.3 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 create or regenerate documentation for reports and graphics when source data is not readily available in electronic files or formats. 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 provide consultation support for creation and revision of procedures, standards, guidelines and templates. 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 and tables 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. The Contractor shall submit, coordinate and distribute final versions of documentation through the Technical Publication Approval System (TPAS). This coordination requires that the Contractor shall interface with the Center Export Administrator for review and determination of ITAR restrictions.

Deliverables and Schedule: Test plans, reports, technical memoranda and presentations shall be delivered according to the schedules approved by the appropriate assessment 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.

2.n Working Environment Safety and Organization: The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.
Required date: Ongoing.
Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.
Meets: No repeated findings or incidents in six-month award fee period.

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.

4. Other Essential Information:

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. Security Clearance:

All Contractor personnel performing the requirements described above will be required to complete appropriate nondisclosure agreements.

6. Period of Performance:

Planned start date: December 1, 2008 Completion date: December 31, 2009

7. NASA Task Management:

(Primary)Technical Monitor (Required): Diana Kerns
M/S: 105 Phone: (757) 864-8473
Technical Monitor (Required): Chris Johansen
M/S: 105 Phone: (757) 864-6077

1. Purpose, Objective, or Background (Optional) This work is a continuation of the work previously performed under TEAMS Task NNL07AM00T by Perot Systems Government Services under subcontract with Swales/ATK.

Point of Contact:
John Whiteley
Program Director
Perot Systems Government Services
NASA Operations
400 Virginia Avenue, South West
Suite 220
Washington, DC 20024
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The scope of this effort is to provide Engineering, Technical and Program Management support to the Office of Chief Engineer (OCE). The required support is generally outlined in the next few paragraphs and specifically described in Section 2 below.

The Office of the Chief Engineer is NASA's primary focus for ensuring that the Agency's technical practices are consistent and based on sound engineering knowledge and judgment. This role requires up-to-date policy documents as well as Engineering Standards that are created or adopted from sources appropriate to the technology and maintained in a manner that assures they are current and relevant to the technologically advanced work that makes up NASA Engineering. To accomplish these mission critical goals, and to advance this important process, the OCE is in the process of establishing the infrastructure, policies, procedures, and practices to institutionalize technical excellence across NASA. To complement the OCE role, the NESC will manage a cadre of Technical Fellows, who will manage the standards for, and oversee the technical aspects of, their assigned disciplines. Review, revision, up-date and maintenance of appropriate NASA standards will be required of each of the Technical Fellows and the Contractor will be required to participate in and help guide that activity.

The Columbia Accident Investigation Board (CAIB) report required NASA to develop and implement an independent technical authority process. Associated with the Technical Authority process is the development, clarification and unification of NASA's technical engineering standards. Specifically: the identification and implementation of a set of mandatory standards; development of NASA Policy Directive (NPD) 8070.6 (Technical Standards), and the establishment of NASA policies for administration of these standards; and the development of NASA Procedural Requirements (NPR) 8070 to establish processes and requirements for these standards. The development and implementation of Program and Project Management requirements, such as NPR 7120.5D (Program and Project Management Requirements) and NPR 7120.8 (R&T Program and Project Management) is required. Assistance is also required in further developing Program/Project Management processes, and training material, in implementation and oversight of policies and processes, as well as development of NASA-wide terminology and other technical/management processes.

Furthermore, the President has issued a Directive giving NASA a defining challenge for the 21st century with compelling new objectives outlined for the Vision for Space Exploration (VSE). In support of this Directive, the NASA Administrator directed the NASA OCE to support the VSE Constellation Program requirements development. The Contractor will provide crucial technical support to, and facilitation of, the NASA OCE Constellation requirements development.

In addition, in order to efficiently support the VSE, NASA also requires systems engineering support to assist the Integrated Enterprise Management Program (IEMP) as it develops Agency Concept of Operations plans and root cause analyses related to its GAO high-risk Corrective Action Plan (CAP) initiatives. The intent of these initiatives is to improve NASA's ability to efficiently provide reliable information to management, support compliance with the Chief Financial Officers Act and other Federal requirements, and strengthen the Agency's Internal Control Program.

The schedule for interim and final reports and a schedule of meetings to be attended are to be developed in coordination with the NASA Office of Chief Engineer, the NASA Engineering and Safety Center and the IEMP Program.

Technical Direction 1 (12/24/08): Updates the initial task order start date to December 23, 2008 as issued by the CO on 12/23/08 (see [TD1] below, Section 6).
Revision 1 (3/5/09): Shortens the period of performance eight months to April 30, 2009 to closeout the task order for NASA's convenience (see [R1] Section 6, below).
Technical Direction 2 (5/29/09): Curtails the period of performance to May 21, 2009 as issued by the CO on 5/22/09 (see [TD2] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. The Contractor shall include a brief tabulated summary of responding activity in the monthly progress reports.

2.1 Provide Engineering, Technical, and Program Management Support to the NASA OCE:

The Contractor may be called upon to conduct special studies or perform focused evaluations. The Contractor shall serve as a consultant to NASA's OCE and assist NASA management to set policy, implement changes, and assess progress with respect to applying the principles of Technical Authority/Technical Excellence in NASA engineering policies, procedures, and practices. The Contractor shall assist the NASA OCE to implement an infrastructure independent of program cost and schedule pressures for technical decision-making. Prior experience with Technical Authority implementations shall be applied to this NASA-wide effort. On-site and off-site resources shall be applied to establishing policies, developing plans, tracking progress, and assisting NASA OCE respond to independent panels and oversight activities. The Contractor shall serve as a consultant to the OCE and assist in the implementation of a survey/assessment process for NASA facilities and programs. The implementation and continual

improvement of the survey/assessment program requires that the Contractor be able to work collaboratively and in real time with the OCE in order to respond to OCE requests with technically qualified and experienced personnel on very short notice.

The Contractor shall perform the following requirements:

1. Assist the OCE management in establishing policies, developing plans, implementing changes, developing communications, and tracking and assessing progress with respect to the OCE Technical Excellence/Technical Authority Initiative as well as assisting OCE management in understanding trends and results, and formulating plans for improvement. The Contractor may also be required to conduct special studies or perform focused evaluations.

2. Assist OCE management liaison with Technical Authorities at NASA Centers to resolve technical issues with potential for impacting safety and/or mission success.

3. Identify all the NASA NPD'S, NPR'S and Engineering Standards affected by Program/Project Management process changes in NPD 7120.4, NPR 7120.5D and NPR 7120.8. The Contractor shall flow down process changes to the sub-tier documents identified.

4. Perform a review of all NODIS directives for Program/Project management impact. Assess developing a basis for identifying all requirements that a Program/Project Manager is responsible to meet. (Note: NODIS is NASA's official system for formal review.)

5. Perform a complete "crosswalk" of requirements from NPR 7120.5C to both the NODIS version of NPR 7120.8 and the final signed version of NPR 7120.8.

6. Support the assessment and resolution of NODIS comments to NPR 1080.1 (Research and Technology Management) and support updating NPD 1080.1 (Research and Technology Policy) and NPR 1080.1 accordingly.

7. Support the implementation of the waiver principles in NPR 7120.5D with specific attention on requirements ownership and delegation of waiver authority.

8. Assist in the development of NASA technical engineering standards including support for the identification and implementation of standards (including a set of mandatory standards); the development of NPD 8070.6, the establishment of a NASA policy for administration of these standards; the development of NPR 8070 to establish processes and requirements for these standards; and conduct an assessment of Center engineering standards.

9. Review NASA technical standards and directives to identify OCE cognizant requirements and recommend changes to these documents to support the current NASA governance model

10. Support the operation of a Constellation Level II Engineering Requirements Working Group.

11. Perform an engineering assessment, including determination of OCE span of interest and recommendations for ownership and concurrence, of 6000 safety and mission assurance technical requirements that must be identified from approximately 62 NPD and NPR documents.

12. Perform an assessment to identify the most effective database to use for housing and categorizing NASA requirements and populate the database as needed.

13. Perform assessments of NASA training, education and qualification programs. The assessments would identify 1) redundancies, 2) gaps, and 3) potential efficiencies and may include training and education associated with technical as well as program management areas.

14. Serve as a consultant to the OCE and assist in the implementation of a survey/assessment process for NASA facilities and programs. Assist OCE in developing the management processes and procedures necessary to conduct both stand alone and joint structured compliance verification activities applicable to all NASA Centers, facilities, and operations. Assist OCE in process development, planning, and implementation of surveys/assessments including the documentation of results and findings and the development of reports and briefing presentations. Assist OCE in providing outreach and training material to ensure successful implementation of the survey/assessment program. Consult and assist in the development and implementation of the NPR 7120.5D surveys scheduled for 2008. The goal of these surveys is to assist the overall Technical Excellence/Technical Authority effort in ensuring that it is based on a clearly articulated set of policies and principles, or elements, of philosophy which can be implemented in an effective and efficient manner.

15. Provide systems engineering support to the Integrated Enterprise Management Program (IEMP) in the development of an Agency-wide Business System Concept of Operations. This support will involve facilitating a number of workshops with subject matter experts across the Agency. In support of the IEMP Integration Manager, the Contractor shall: perform benchmarking; develop workshop agenda's and materials; develop straw-man processes and text; collect, collate and maintain information including meta data; and develop and disposition drafts including the final.

16. Provide systems engineering support to the IEMP in the development of a corrective action plan that addresses the Agency's high priority gaps. This support will include the application of systems engineering techniques to perform causal analyses, identify corrective actions, define requirements, and develop an integrated plan for addressing the high priority gaps.

17. Assist the OCE in the development and implementation of the Baseline Performance Review (BPR) process for NASA. The implementation and continual improvement of the BPR process requires that the Contractor have direct experience with, and possess full knowledge of, the NASA HQ previous BPR activities and also to be able to work collaboratively, and in real time, with OCE in order to respond to OCE NOCs with technically qualified and experienced personnel.

18. The NASA Engineering Network (NEN), a knowledge management system offered by the NASA Office of the Chief Engineer, networks NASA engineers to NASA's vast knowledge resources, both documented and tacit. The NEN provides advanced collaboration and document management

through a seamless interface into NX, a knowledge network technology offered by NASA Ames Research Center. In support of NEN and NX the Contractor shall:

1)Provide continued operational support for NEN users, NEN-NX interfaces and custom developments in support of the NEN-NX interface
2) Roll out enhanced security services for select NEN users through MINX
3) Develop and deploy enhanced collaboration services through NEN
4) Support regular tagups, reviews, and status reports
5) Provide documentation as needed

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Monthly technical reports are required and shall include, at a minimum, tasks accomplished during the reporting period, and tasks projected to be accomplished during the next reporting period, significant risks, issues within the contractor's control, or issues requiring Government attention, and summary of travel performed for the month (including travelers name, purpose, place and date). Some ad hoc reports may be required by mutual agreement.

Meeting notices, agendas, minutes, action items, draft reports and correspondence shall be provided for presentation to user organizations as necessary.

Final report and/or briefing charts shall be submitted not later than December 31, 2009.

2.1.3 Performance Metrics/Standards:
Exceeds: Delivers requirements ahead of schedule
Meets: Delivers requirements on schedule

2.n Working Environment Safety and Organization
The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.
2.n.2 Required date: Ongoing.
2.n.3 Performance Metrics:
Exceeds: No cited findings or reportable incidents in six-month award fee period.
Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

4. Other Essential Information:

Travel & Cost of Materials

Travel will be required for this effort. Actual travel will be determined during the planning process.

The use of incidental materials may be required in the performance of this effort, although the exact type and quantity is unknown at the inception of this subcontract and can be identified only as this work progresses. Prior to proceeding on any part of this effort that requires the purchase or manufacture of such incidental materials, the contractor is required to provide a description of the material and the price to purchase or manufacture this material to NASA for approval.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): This PWS is open to NOTICES OF CLARIFICATION to clarify continuing requirements. It is the Contractor's responsibility to review each new work request for organizational conflict of interest (OCI) and implement appropriate mitigation strategies. No ITAR or security issues are anticipated with this task.

6. Period of Performance:

Planned start date: TD1 12/23/08 Completion date: R1 ~~12/31/09~~ TD2 ~~4/30/09~~ ***5/21/09***

7. NASA Task Management:

Technical Monitor (Required): Roger Forsgren, OCE, NASA Headquarters
M/S: 2J70 Phone: 202.358.0859

Other POC (Optional): Harold Bell, OCE, NASA Headquarters
M/S: 2E69 Phone: 202.258.1040

TASK ORDER NUMBER: 074D3-NNL09AM08T Revision: 0 Change: 0 Date: December 4, 2008

Title: Powered Wind Tunnel Testing, Techniques, Data Analysis and Documentation Support for Orion

1. Purpose, Objective, or Background (Optional)

This work supports Exploration Systems Mission Directorate (ESMD) and the LaRC Orion Program Office efforts to document the aerodynamic characteristics of the Orion Launch Abort Vehicle (LAV) and Crew Module (CM). The aerodynamic characteristics are determined through experimental testing in ground based test facilities at trans to supersonic Mach numbers, with and without jet interaction effects coming from jet motors on the LAV or CM.

Note: Contractor familiarity with wind tunnel model design, instrumentation, and fabrication, and Contractor experience in wind tunnel test techniques, including flow visualization and powered testing and calibration techniques will be required for the work described below. This capability is already being utilized on task order 061D3-NNL07AN01T.

Technical Direction 1 (12/24/08): Updates the initial task order start date to December 23, 2008 as issued by the CO on 12/23/08 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

- The Contractor shall oversee the wind tunnel model design and fabrication process to ensure effective wind tunnel models are procured
- The Contractor shall set up and execute wind tunnel tests at transonic and supersonic speeds.
- The Contractor shall analyze wind tunnel test data for applicability, accuracy, data trends, and quality.
- The Contractor shall support the pre- and post-test documentation process.

The following contractor activity is anticipated:

Test	Activity	Duration	Start
25-AA	Oversee Model design & fabrication	10 months (part-time)	Dec 2008
25-AA	Set up & execute UPWT wind tunnel test	6 weeks	Oct 2009
25-AA	Post-Test data reduction/documentation support	6 weeks	Mid-Nov 2009
24-AA	Test Preparation & Support	6 months (part-time)	Jan 2009

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Deliverable	Date	Format
Status reports at CAP Aero Testing Telecon	Weekly	Verbal or electronic

25-AA model design review	June 2009 ?	Electronic
25-AA pre-test documentation	3 weeks prior to test entry	MS Word
25-AA wind tunnel test data	2 weeks after test completion	Electronic or Excel

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets Standard: All wind tunnel support work meets governments standards and is completed within schedule

Exceeds Standard: All wind tunnel support work meets government standards and is completed ahead of schedule

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Windchill account

4. Other Essential Information:

Travel will be required per the following itinerary:

At this time specific travel requirements are not known; however, the Orion wind tunnel test schedule may require the Contractor to provide expertise at locations outside of LaRC.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

The Contractor shall be a US citizen and be able to work with ITAR data.

6. Period of Performance:

Planned start date: [TD1] ***December 23, 2008***

Completion date: December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Francis Greene
M/S: 408A Phone: 864-4381

Other POC (Optional): Gregory Brauckmann
M/S: 408A Phone: 864-5234

TASK ORDER NUMBER: 024D2-NNL09AM09T Revision: 0 Change: 0 Date: December 10, 2008

Title: Electronic Support for the Electronic Systems Branch for ALHAT and other Flight projects Avionics

1. Purpose, Objective, or Background (Optional) The Electronic Systems Branch (ESB) is required to support the avionics development for various projects being fabricated at LaRC. Digital and analog electrical engineers are needed to help accomplish this mission. At the present time an electrical engineer is needed by ESB to support the avionic systems on the ALHAT project. This task order may be revised to add other subtasks when the detailed requirements become defined.

2. Description of the Work to be Performed:

2.1. Support for the ALHAT Program

a. The Contractor shall provide electrical engineering support for the ALHAT Program by teaming with the PI in areas involving the avionics systems.

b. The Contractor shall design and build a circuit that will linearise the voltage frequency shift of a commercially built 6 GHz Variable Frequency Oscillator (VCO). This task shall consist of characterizing the VCO and building a circuit with an embedded microcontroller and a digital to analog converter to linearise the VCO frequency shift with a linear analog input.

c. The Contractor shall investigate building a small customized synthesizer to replace a larger commercial unit currently being used in the Lidar system.

d. The Contractor shall provide drawings, functional testing, integration testing and environmental testing of flight instrumentation.

e. The Contractor shall provide electrical/electronic fabrication of ground test hardware to support testing of the flight instrumentation for the flight test program. Fabrication procedures will be provided by the flight project.

f. The Contractor shall maintain configuration management for all drawings and hardware he develops.

2.1.1. Milestones: There are no specific milestones under this task.

2.1.2 Deliverables and Schedule:

1. Configuration Control of all hardware and drawings specified by the project
2. Drawings and test results
3. Ground test hardware
4. Reports, test plans, schedules, system-level and subsystem designs of flight hardware, trade studies requested by the Avionics Lead shall be delivered electronically to the TM within two weeks after the completion of the requested work. (ALHAT support is anticipated to last approximately through August 2009)

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets Requirements will be defined as delivery by due date of reports/drawings/schedules/test plans/designs/hardware trade studies requested by the Avionics Lead. Exceeds Requirements will be defined as delivery of said items one week or more prior to due date.

2.2 (Requirement/subtask number two):

This task will cover other project avionics needs (ex. Future CERES FM 6 avionics needs). The task description, etc. will be added as they are received.

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

1. Lab Facilities at LaRC
2. Specialized printers and plotters
3. Test equipment specific to this task order

4. Other Essential Information: None

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

No security clearance required.

Note: This activity requires the use of sensitive and ITAR controlled information. A Non-disclosure Agreement (NDA) shall be executed and kept on file. The person supporting this task shall be qualified to handle ITAR controlled information. All sensitive and ITAR controlled information shall be managed in accordance with NASA policy.

6. Period of Performance:

Planned start date: January 2, 2009 Completion date: December 31, 2009

TASK ORDER NUMBER: 024D2-NNL09AM09T Revision: 0 Change: 0 Date: December 10, 2008

Title: Electronic Support for the Electronic Systems Branch for ALHAT and other Flight projects Avionics

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7. NASA Task Management:

Technical Monitor: Marvin Beatty

M/S: 488 Phone:757.864.1689

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 012E4-NNL09AM10T Revision: 0 Change: 0 Date: January 5, 2009

Title: COMSEC Engineering Support to NASA Headquarters Space Operations Mission Directorate

1. Purpose, Objective, or Background (Optional)

The purpose of the activity is to provide unclassified and classified Space Communications Security (COMSEC) engineering support to NASA Headquarters Space Operations Mission Directorate (SOMD) for activities including, but not limited to Tracking & Data Relay Satellite System (TDRSS), other National Security programs, and Projects related to Constellation Program communications support. Some support and service will be provided at a security level requiring a Top Secret (TS) clearance with eligibility for Top Secret/Sensitive Compartmented Information (TS/SCI). Participants(s) must have a minimum of two(2) years, National Security Agency (NSA) level Information Systems Security Engineering experience, knowledge and understanding of national space assets in order to perform vulnerability and threat assessments, experience with the national Electronic Key Management System (EKMS) program and understanding of the national COMSEC program, experience with other Federal Government National Security Systems in order to understand interoperability issues and offer advice and solutions for NASA programs and projects, must be available for full time HQs tasking on critical National Security System (NSS) issues, must be able to travel to NASA centers and attend inter-agency meetings on short notice (usually within 48 hours), and must have current TS clearance with eligibility for TS/SCI in order to participate in meetings and to review documentation associated with NASA efforts. Experience with and understanding of the Department of Defense (DoD) Global Information Grid (GIG) architecture as well as the Transformational Communications Architecture (TCA).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Must have expert knowledge and experience with the Space COMSEC research and development (R&D) engineering standards and practices in order to perform the following:

2.1 - The Contractor shall perform TS/SCI threat, risk and vulnerability assessments of space platforms, vehicles, communications systems and subsystems, including evaluation of information systems security engineering processes, procedures and protocols.

2.1.1 Deliverables and Schedule:

Deliverable: A Threat and Vulnerability Assessment Report of the Platform, system or subsystems being evaluated.

Schedule: 30 days after the Assessment is completed (ongoing).

2.2 – The Contractor shall provide direct participation and support with the National Space Information Security (INFOSEC) Steering Council, Executive Committee, and associated working groups (e.g., COMSEC).

2.2.1 Deliverables and Schedule:

Deliverable: A summary of minutes after meetings and working group sessions.

Schedule: 30 days after the meetings and working group sessions conclude (ongoing).

2.3 – The Contractor shall assist in the Analysis of low Earth orbit (LEO) and geo-synchronous satellite radio frequency and laser command, control, telemetry, and data communications with ability to recommend countermeasures based on sophisticated space threat, risk, and vulnerability assessments.

2.3.1 Deliverables and Schedule:
Deliverable: Recommendations in the form of a report or presentation.
Schedule: Ongoing

2.4 – The Contractor shall Collaborate and provide first-hand knowledge and experience with NSA space encryption product design, encryption algorithm analysis, TEMPEST analysis, NSA encryption product certification, and large-scale program system integration to support NASA HQ SOMD Projects.

2.4.1 Deliverables and Schedule:
Deliverable: Product data, Reports, NSA correspondence and recommendations in the form of a report or presentation
Schedule: Ongoing interaction with NASA HQ SOMD

2.5 – The Contractor shall possess the ability to present and represent NASA's strategic positions and concepts of Information Security (INFOSEC), COMSEC at DoD Global Information Grid and Encryption Modernization meetings and working groups.

2.5.1 Deliverables and Schedule:
Deliverable: NASA INFOSEC & COMSEC studies and/or data, NSA correspondence and recommendations in the form of a report or presentation
Schedule: Ongoing interaction with NASA HQ SOMD

2.6 – The Contractor shall investigate and understand the White Sands Ground Terminal (WSGT) router issues, research the three available options from a security standpoint keeping National and NASA policy in place. The Contractor shall Develop a paper / briefing on all options and recommendations.

2.6.1 Deliverables and Schedule:
Deliverable: Security Option briefing and recommendations in the form of a report or presentation
Schedule: September 30, 2009.

2.6 Subtask 1 – The Contractor shall work with Mr. Ken Perko at NASA GSFC with regards to the WSGT routers and systems.

2.6.1 Subtask 1 Deliverables and Schedule:
Deliverable: N/A
Schedule: N/A

options and security approaches.

2.6 Subtask 2 – The Contractor shall provide support and engineering review of Space Link Extension (SLE) with Dr. Adrian Hooke of NASA GSFC.

2.6.1 Subtask 2 Deliverables and Schedule:
Deliverable: N/A
Schedule: N/A

2.7 – The Contractor shall perform a turnover of activities with Dr. Harry Shaw (NASA GSFC) on Space Communications and Navigation (SCaN) to become the lead engineer understanding the role and security posture of the SCaN Constellation Integration Project (SCIP) and how it directly relates to SCaN and Programs using SCaN services. The Contractor shall be able to obtain all information from the last SCAN-SCIP Security Technical Interchange Meeting (TIM) relating to Networks, IT Security and implementation/development architectures. { NOTE: SCIP has now been relegated to NASA HQ Space Communications and Navigation (SCaN) Systems Engineering, with work delegated between Engineering Services and Network Services}

2.7.1 Deliverables and Schedule:
Deliverable: Provide an overview synopsis of how SCIP will provide both INFOSEC and COMSEC support to Constellation Program in the form of a report or presentation
Schedule: September 30, 2009.

2.7 Subtask 1 – The Contractor shall help outline and develop the SCaN Systems Security Plan.

2.7.1 Subtask 1 Deliverables and Schedule:
Deliverable: SCAN SSP
Schedule: September 30, 2009

2.7 Subtask 2 – The Contractor shall work with key personnel associated with the Space Network Extension at Blossom Point in support of SCaN expansion activities related to communications supporting NASA Programs..

2.7.1 Subtask 2 Deliverables and Schedule:
Deliverable: Option briefing and recommendations in the form of a report or presentation
Schedule: September 30, 2009

2.8 – The Contractor shall work with the Constellation Program (CxP) Systems Engineering & Integration (SE&I) Software and Avionics Integration Office (SAVIO) Security Lead (Mike Pajevski) for SCaN related

topics that are affected or that affect the interaction with CxP IT Systems.

2.8.1 Deliverables and Schedule:

Deliverable: Security Option briefings and recommendations in the form of a report or presentation

Schedule: September 30, 2009.

2.9 – The Contractor shall be able to independently support the TDRSS Program, participate in Threat and Vulnerability Assessments (TVA) required of TDRSS, and provide assistance to ensure the Certification & Accreditation (C&A) of the TDRSS Program as it relates to IT Security and Information Systems validation.

2.9.1 Deliverables and Schedule:

Deliverable: Provide inputs to reports and Threat and Vulnerability assessment reports to support C&A of TDRSS IT Security Systems

Schedule: September 30, 2009.

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed NASA facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

N/A

4. Other Essential Information:

The Contractor should possess working knowledge and experience with the Committee on National Security Systems Committees, Sub-committees and working groups.

The Contractor skills should include having intimate knowledge and experience with the U.S. Air Force Crypto logic Support Group space product division and encryption modernization efforts to include knowledge of "benign-fill" applications related to space encryption products.

The Contractor must have existing eligibility for National Security space systems related clearances, personal "contacts", and activities across the Department of Defense and the Intelligence Community to include the National Security Agency, National Reconnaissance Office (NRO), and the National Security Space Office (NSSO), which was established in May 2004. The NSSO was formed by combining the

National Security Space Architect (NSSA) and the National Security Space Integration (NSSI) office. The NSSO will build on the functions and processes of NSSA and NSSI and add new capabilities in the areas of NSS-wide enterprise engineering and functional area integration.

The Contractor must be badged out of NASA LaRC and have a NASA email account (with PKI certificate capability) that originates from NASA LaRC.

Expectations are for an approximate $4,000 monthly travel budget.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): Top Secret, Special Compartmented Information (TS-SCI) clearance required. Other requirements include the handling of ITAR and SBU information on a regular basis, as well as handling Classified National Security information (CNSI).

6. Period of Performance:

Planned start date: January 23, 2009 Completion date: September 30, 2009

7. NASA Task Management:

Technical Monitor (Required): Frederic Stillwagen
M/S: 362 Phone: 757 864-9061

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 76D3-NNL09AM12T Revision: 0 Change: 0 Date: February 27, 2009

Title: **Structural Damage Flight Experiment Model Development and Support**

1. Purpose, Objective, or Background (Optional) (Support for this effort has been provided under SAMS task order 25RDC.)

A low cost test bed is being used to execute airframe damage scenarios in flight as part of the research into airframe damage assessment and mitigation under the Integrated Vehicle health management project. The test bed is a subscale aircraft whose wing and load bearing components are instrumented to measure loads during execution of flight maneuvers. The load data is recorded for a number of damage configurations for analysis and technology development. The goal is to use the test bed to develop techniques for detecting structural anomalies and determining their impact on flight control parameters.

The test bed vehicle is a commercially available Edge 540 radio control model that is modified for electric flight. Instrumentation is added for load measurements. A number of damage configurations are flown and compared with the baseline undamaged configuration.

Technical Direction 1 (4/2/09): Updates the initial task order start date to April 2, 2009 as issued by the CO on 4/2/09 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Vehicle Integration and Mechanical Design

- The Contractor shall install appropriate instrumentation on baseline (as-built) configurations.
- The Contractor shall perform mechanical design, fabrication, and appropriate analysis associated with Edge 540 wing modifications to ensure physical integrity of the wing under anticipated flight conditions.
- The Contractor shall perform load testing to determine ultimate load for wing, elevator, and rudder for baseline and modified configurations
- The Contractor shall perform component testing on any modified or new hardware; qualitatively determine device characteristics and evaluate the impact of this modification on the aircraft.
- The Contractor shall assemble and repair models, and fabricate components for aircraft models.
- The Contractor shall deliver designs and as-built drawings in electronic form that can be imported into CAD software and electronic configuration management database.
- The Contractor shall be responsible for vehicle maintenance and documentation actions.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

- Documentation of load testing results, criteria, and procedures.
- Flight ready instrumented baseline and modified wings.
- Design drawings and as-built documentation for any aircraft modification that will impact structural integrity or mass balance.
- Monthly technical reports that detail status of ongoing work and highlight any concerns with schedule, budget, or technical feasibility.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

MEETS:

Modified wing hardware, wing modification design drawings and as-build documentation delivered in electronic form by task completion date.

EXCEEDS:

Modified wing hardware, wing modification design drawings and as-build documentation delivered in electronic form 2 weeks prior to task completion date.

3. Government Furnished Items:

All flight vehicles and other equipment associated with test bed development.

Computer hardware and software support, including license to Pro-Engineer CAD Software.

Access to small machine shop equipment.

4. Other Essential Information:

5. Security Clearance:

6. Period of Performance:

Planned start date: [TD1] ***April 2, 2009*** Completion date: July 31, 2009

7. NASA Task Management:

Technical Monitor (Required): **Cuong C. Quach**

M/S: 130 Phone: 757-864-6688

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 025D2-NNL09AM13T Revision: 0 Change: 0 Date: March 16, 2009

Title: ALHAT Software Engineering Support for Sensor Suite Field Tests

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to provide software engineering support for the Exploration Technology Development Program's (ETDP) Autonomous Landing and Hazard Avoidance Technology (ALHAT) Project for current and upcoming sensor suite field tests. The objective of the ALHAT project is to advance the Technology Readiness Level (TRL) of hazard detection and avoidance (HDA) and Terrain Relative Navigation (TRN) sensors to TRL 6 by the Altair (Lunar Lander) Project's Preliminary Design Review (PDR). The project has completed two field tests thus far and is currently in the development stages for field test #3. The sensor suites for the first two helicopter field tests consisted of visible cameras, an Advanced Scientific Concepts (ASC) Flash Lidar, a Laser Velocimeter, and the computer hardware and software for data acquisition and storage. The sensor suite for Field Test #3, which will fly on a B200 aircraft, consists of two visible cameras, a flash lidar, a laser altimeter, and the computer hardware and software for data acquisition and storage. The project has plans for several more field tests in the future.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall develop, test, and document assigned components of the sensor suite software to control the sensors and acquire / store data for ALHAT Field Test #3. The Contractor shall support sensor suite integration and test at JPL, the aircraft integration and shakeout test, and the flight tests at the Nevada test site.

2.1.1 Milestones (Optional):

- Complete sensor suite integration and test, and successfully complete pre-ship review (PSR).
- Deliver sensor suite to JPL to support integration and test schedule, per project schedule (May 8, 2009)
- Complete integration and test at JPL per project schedule (May 29, 2009)
- Complete aircraft integration and shakeout test per project schedule (June 19, 2009)
- Complete flight tests per project schedule (June 26, 2009)

2.1.2 Deliverables and Schedule (Required):

- Sensor suite software due at PSR.
- Sensor suite documentation due at PSR.
- Sensor suite test reports due at PSR.
- Monthly activity report, due by 5th work day each month.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Sensor suite software tasks are completed on schedule, and products contribute to a successful flight test.

Exceeds: Sensor suite software tasks are completed ahead of schedule, and product contributes to a successful flight test.

2.2 (Requirement/subtask number two): *Note: This requirement is for period of performance planning at the*

same level of support as Subtask 2.1 – specific milestones, deliverables, dates, and performance metrics are dependent on 2.1 results and will be added later as they become clearly defined.

The Contractor shall develop, test, and document assigned components of the sensor suite software to control the sensors and acquire / store data for ALHAT Field Test #4, #5, and #6. The Contractor shall support sensor suite integration and test, the aircraft integration and shakeout test, and the flight tests at the test site.

2.n Sub-Task n - Working Environment Safety and Organization (Required)
The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Contractor shall perform software development and testing in the ALHAT Laboratory. The lab consists of the sensors and the computer hardware and software for sensor control and data acquisition and storage.

Desk and phone will be provided in close proximity to ALHAT software team.

4. Other Essential Information:
There is a high probability that the project schedule for Field Test #3 will change due to technical issues.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):
ESD Certification, Laser Safety Certification.

6. Period of Performance:

Planned start date: 3/16/2009 Completion date: 12/31/2009*

*It is anticipated that this task will be revised to run the life of the TEAMS contract as requirements become clearly defined.

7. NASA Task Management:

Technical Monitor (Required): Ruben Remus
M/S: 472 Phone: x47106

Alternate Technical Monitor: Kathryn Stacy
M/S: 472 Phone: x46719

TASK ORDER NUMBER: 025D2-NNL09AM13T Revision: 0 Change: 0 Date: March 16, 2009

Title: ALHAT Software Engineering Support for Sensor Suite Field Tests

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to provide software engineering support for the Exploration Technology Development Program's (ETDP) Autonomous Landing and Hazard Avoidance Technology (ALHAT) Project for current and upcoming sensor suite field tests. The objective of the ALHAT project is to advance the Technology Readiness Level (TRL) of hazard detection and avoidance (HDA) and Terrain Relative Navigation (TRN) sensors to TRL 6 by the Altair (Lunar Lander) Project's Preliminary Design Review (PDR). The project has completed two field tests thus far and is currently in the development stages for field test #3. The sensor suites for the first two helicopter field tests consisted of visible cameras, an Advanced Scientific Concepts (ASC) Flash Lidar, a Laser Velocimeter, and the computer hardware and software for data acquisition and storage. The sensor suite for Field Test #3, which will fly on a B200 aircraft, consists of two visible cameras, a flash lidar, a laser altimeter, and the computer hardware and software for data acquisition and storage. The project has plans for several more field tests in the future.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall develop, test, and document assigned components of the sensor suite software to control the sensors and acquire / store data for ALHAT Field Test #3. The Contractor shall support sensor suite integration and test at JPL, the aircraft integration and shakeout test, and the flight tests at the Nevada test site.

2.1.1 Milestones (Optional):

- Complete sensor suite integration and test, and successfully complete pre-ship review (PSR).
- Deliver sensor suite to JPL to support integration and test schedule, per project schedule (May 8, 2009)
- Complete integration and test at JPL per project schedule (May 29, 2009)
- Complete aircraft integration and shakeout test per project schedule (June 19, 2009)
- Complete flight tests per project schedule (June 26, 2009)

2.1.2 Deliverables and Schedule (Required):

- Sensor suite software due at PSR.
- Sensor suite documentation due at PSR.
- Sensor suite test reports due at PSR.
- Monthly activity report, due by 5th work day each month.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Sensor suite software tasks are completed on schedule, and products contribute to a successful flight test.

Exceeds: Sensor suite software tasks are completed ahead of schedule, and product contributes to a successful flight test.

2.2 (Requirement/subtask number two): *Note: This requirement is for period of performance planning at the*

same level of support as Subtask 2.1 – specific milestones, deliverables, dates, and performance metrics are dependent on 2.1 results and will be added later as they become clearly defined.

The Contractor shall develop, test, and document assigned components of the sensor suite software to control the sensors and acquire / store data for ALHAT Field Test #4, #5, and #6. The Contractor shall support sensor suite integration and test, the aircraft integration and shakeout test, and the flight tests at the test site.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Contractor shall perform software development and testing in the ALHAT Laboratory. The lab consists of the sensors and the computer hardware and software for sensor control and data acquisition and storage.

Desk and phone will be provided in close proximity to ALHAT software team.

4. Other Essential Information:

There is a high probability that the project schedule for Field Test #3 will change due to technical issues.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

ESD Certification, Laser Safety Certification.

6. Period of Performance:

Planned start date: 3/16/2009 Completion date: 12/31/2009*

*It is anticipated that this task will be revised to run the life of the TEAMS contract as requirements become clearly defined.

7. NASA Task Management:

Technical Monitor (Required): Ruben Remus
M/S: 472 Phone: x47106

Alternate Technical Monitor: Kathryn Stacy
M/S: 472 Phone: x46719

TASK ORDER NUMBER: 026D2-NNL09AM14T Revision: 0 Change: 0 Date: March 31, 2009

Title: Model Accreditation for Simulation of the Orion Crew Module Landing System

1. Purpose, Objective, or Background (Optional):

NASA Langley Research Center (LaRC) is responsible for testing and analysis of the Orion Crew Module (CM) land landing system. Although the primary landing site for the Orion CM will be an ocean site, studies are now being conducted to characterize land landings onto the Kennedy Space Center (KSC) following launch pad aborts. The beach area around the launch pad is the most likely land landing site following a launch pad abort coupled with onshore winds.

To assess abort land landings, NASA Langley is planning a series of half-scale (geometric) CM boiler plate fixture impacts onto sand. The surrogate sand to be acquired by LaRC needs to match KSC sand as closely as possible. In addition to replicating the sand composition, the depth of the sand, the moisture content of the sand, and the density of the sand landing surface need to be chosen properly.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Subtask 1: Assess selected constitutive properties of the surrogate sand for an LS-DYNA soil numerical model:

In this subtask, the Contractor shall assess the selection of the surrogate sand, and the sensitivity of grain size, moisture, density, and compaction on the resultant accelerations. Sand material models in LS-DYNA are planned to be MAT5 models, which have been generated for the KSC sand. An assessment of the suitability of the MAT5 sand model is required, as well as the formulation used in the model: Lagrange, ALE (Arbitrary Lagrange Euler), Euler, SPH (Smooth Particle Hydrodynamics), etc. Reviews of previous LS-DYNA models and papers may be required.

2.1.1 Milestones (Optional):

The Contractor support shall be no more than 120 consulting hours.

2.1.2 Deliverables and Schedule (Required):

The Contractor shall deliver an engineering report assessing the program plans and past modeling efforts. Required by: June 29, 2009.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting"):

The minimum acceptable level will be an engineering report assessing the program plans and past modeling efforts. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and range of concepts that have potential for improved dynamic simulation of the soil/CM impact.

2.n Sub-Task 2.n - Working Environment Safety and Organization (Required)

In the event episodic on-site LaRC access is required, the Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

None.

4. Other Essential Information:

None.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

TBD.

6. Period of Performance:

Planned start date: April 20, 2009 Completion date: June 29, 2009

7. NASA Task Management:

Technical Monitor (Required): Robin D. Tutterow
M/S: 432 Phone: 757-864-7168

Other POC (Optional): Lynn M. Bowman
M/S: 190 Phone: 757-864-5426

TASK ORDER NUMBER: 001E6-NNL09AM15T Revision: 0 Change: 0 Date: April 9, 2009

Title: Program Analysis and Control Services

1. Purpose, Objective, or Background (Optional)

Technical Direction 1 (5/29/08): Updates the initial task order start date to June 1, 2009 as issued by the CO on 5/27/09 (see [TD1] below, Section 6).

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

General Requirements

Description: Unless otherwise specified, the Contractor shall provide program analysis and control services to technical programs/projects throughout Langley Research Center. Program/project offices are located in various buildings across the Center. The Contractor shall provide resources planning, budgeting, control, analyses, documentation and reporting on required project(s). Duties typically include extensive participation or lead in the development of the Work Breakdown Structure (WBS) for the program or project and any major contractual efforts; contractor financial reporting requirements; analyses of contractor resources performance versus plan and outlook for remaining contractual effort; the analysis of time-phased resources schedules consistent with the program plan and recurrent assessments of performance versus these plans, including, but not limited to, earned value management; development and maintenance of an accounting system suited to assigned program or project(s); and the preparation of required financial planning, control, or reporting documents (e.g., spending plans and program operating plans).

Deliverables: The Contractor shall develop an integrated monthly report for the project 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 program analysis products required:

- Analysis of plans versus actuals for finances in total and by cost element (procurement, labor, travel and pools)
- Analysis of plans versus actuals for workforce (civil servant and contractor)
- Earned value reports and analysis
- Management reports
- Analytical reports and "white papers"
- Management bullet/presentation charts

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

a) Data integrity in reporting. Verifying the data in the spreadsheets/databases are accurate, up to date, and can support all management and working level reporting and analysis requirements
b) Once a baseline has been established, changes to the baseline will be maintained and documented in the project's desired format
c) The Contractor shall deliver all deliverables on time. The specific deliverables and schedule of deliverables may vary by subtask.
d) The Contractor shall follow the requirements of NASA and Langley procedures for Budget Formulation, Budget Execution, and Program/Project Management, including, but not limited to: NPR 9420.1, NPR 9470.1, LPR 7510.1, LPR 7120.6, NPR and LPR 7120.5x.

Standard 1: Develop and deliver Monthly Management Report(s) (MMR) for all subtask elements.

CUSTOMER SERVICE/RATING:

Excellent: The MMR 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 baseline financial and workforce data. Anticipate project needs and generate analytical reports to provide value added to the customer in support of project requirements and team meetings.

CUSTOMER SERVICE/RATING:

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

Standard 3: Produce and deliver accurate ad hoc reports in support of Center Management Council (CMC) 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 advice to projects identified in the task order as subtasks. This consultation may be in the form of reports (Trend Analysis, Earned Value Analysis) or financial management recommendations.

CUSTOMER SERVICE/RATING:

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

Subtask Description: The Contractor shall provide program analysis and control support to develop and manage budgets and workforce for the following Exploration and Space Operations Directorate (ESOD) and Flight Projects Directorate (FPD) subtasks. The budget development and execution shall include directing and working with all ESOD and FPD project, subproject, element, and task managers from LaRC and other NASA centers, as appropriate. The Contractor shall work with the appropriate individuals to develop resource loaded schedules, suitable for earned value management and integrated, as appropriate, to include all work performed by the project.

Subtask Deliverables (To Be Determined by Subtask Project Manager):

2.1: Subtask 1 -- Exploration and Space Operations and Flight Projects Directorate Projects:

a. The Contractor shall serve as a financial expert on budgeting and financial management issues and activities, including historical costs. Determines fiscal budget and human resources requirements and controls expenditures. Determines resource requirements and recommends resource allocations based on priorities and needs. The Contractor shall establish and meet deadlines based on Government priority and established work request procedures when accepting work. The Contractor shall respond to ad hoc customer inquiries. During budget formulation and execution activities urgent requirements may necessitate immediate action. Intermediate or advanced use of standard business software applications such as Word, Excel, and PowerPoint is required for doing in-depth analysis and presentation of workforce and financial data. Knowledge or experience using NASA-unique applications SAP, SAP Business Warehouse, Workforce Integrated Management System (WIMS), Programmatic Template (PT), and Funds Control System, is desired. The Contractor shall enter, maintain, retrieve, analyze, and manipulate cost and schedule data and provide recommendations relating to LaRC programs and projects. Upon request, provide ESOD and FPD personnel with the ESOD and FPD training materials for the various program analysis tools or processes.

b. The Contractor shall serve as project expert on budgeting and financial management issues and activities, including historical costs. Determines fiscal budget and human resources requirements and controls expenditures. Determines resource requirements and recommends resource allocations based on priorities and needs. Coordinates team efforts in conducting comprehensive studies or projects dealing with significant changes in workforce distribution, positions, or related organizational structures. Uses complex analytical techniques to make recommendations to project management regarding workforce adjustments.

c. The Contractor shall provide expert analysis and evaluations to management that encompass programmatic milestones, schedules, and budgetary resource planning and execution required for

effective management, operations, and decision making in support of a project/program or functional area. Provides interpretations of financial reports, statements, and data that point out trends, identify deviations from standards and/or plans, and project data into the future. Designs and develops integrated program control (financial, workforce, and schedule) reports for management officials. on a daily, weekly, and monthly basis to be used for tracking budget plans, financial and overall performance (including Earned Value Management as required), workforce, variances, and budget trends and changes. Perform required plan vs. actual analysis, formulate recommendations and provide budget projections, when appropriate. Where applicable, manage and maintain the earned value management (EVM) integrated baseline for the project. Provide monthly analysis and develop independent estimates at completion on a quarterly basis using various earned value methods for developing estimates at completion.

d. The Contractor shall research and analyze problems, issues, or program requirements such as decreasing funding profiles, changes in program/project scope, and adjustments to schedule (acceleration or deceleration) or any other significant change that could affect workforce, financial resources, or schedule. Develop cost estimates associated with significant problems or scope change. Provide expert analysis and advice on complex program issues. Analyze program accomplishments and recommend to the project the appropriate financial and workforce resources needed for the assigned program area. Based on operations and changing program requirements, identify relevant issues. Collect relevant information from many varied sources, some of which are difficult to access. Devise new analytical techniques to evaluate findings and make authoritative recommendations.

e. The Contractor shall prepare charts, exhibits, and reports pertaining to resource data to be used for program/project and other management analyses and reviews. Graphics data may come from established databases, spreadsheets, or information provided by Government program analysts. Provide data input into IEMP, PT, FOCUS (ESMD), Project Management Tool (PMT - developed by Ames Research Center), Funds Control System, Purchase Requests, and WIMS. Maintain proficiency with computer graphics software being used by the Government programs/projects to generate charts and reports and with the data sources that serve as the basis for the charts and reports.

f. The Contractor shall communicate effectively with management and technical specialists at Langley, other Centers, NASA HQ, and Industry.

g. The Contractor shall maintain knowledge and understanding of current LaRC business practices and technical mission. Recommend changes and/or improvements needed to better accomplish the requirements of this task.

2.1.1: Deliverables:

a. Monthly Management Report—the Contractor shall analyze all financial and workforce information and submit a monthly report by the 10th of every month.
   i. Analysis of plans versus actuals for finances in total and by cost element (procurement, labor, travel and pools)
   ii. Analysis of plans versus actuals for workforce (civil servant and contractor)

iii. Earned value reports and analysis, as needed
iv. Management reports such as Center Management Council (CMC), Technical, Cost, Schedule Review (TCSR), Integrated Center Management Council, ESOD Monthly Management Report (MMR)

b. Provide program analysis support for weekly and monthly meetings and teleconferences; attend other program and project meetings, as necessary.
   i. Analytical reports and "white papers"
   ii. Management bullet/presentation charts
c. Provide monthly program analysis to identify financial or schedule conflicts and issues.
d. As needed – Advise the management team on issues associated with resource-loaded schedules.

2.2: Subtask 2 – "Surge" Support to Exploration and Space Operations and Flight Projects Directorate Projects:

a. The Contractor shall serve as a financial expert on budgeting and financial management issues and activities, including historical costs. The Contractor shall establish and meet deadlines based on Government priority and established work request procedures when accepting work. The Contractor shall respond to ad hoc customer inquiries. During budget formulation and execution activities urgent requirements may necessitate immediate action. Intermediate or advanced use of standard business software applications such as Word, Excel, and PowerPoint is required for doing in-depth analysis and presentation of workforce and financial data. Expert knowledge using NASA-unique applications SAP and SAP Business Warehouse, is desired. Knowledge of NASA-unique applications Workforce Integrated Management System (WIMS), Programmatic Template (PT), and Funds Control System, is desired. The Contractor shall enter, maintain, retrieve, analyze, and manipulate cost data and provide recommendations relating to LaRC programs and projects. Upon request, provide ESOD and FPD personnel with the ESOD and FPD training materials for the various program analysis tools or processes.
b. The Contractor shall prepare charts, exhibits, and reports pertaining to resource data to be used for program/project and other management analyses and reviews. Graphics data may come from established databases, spreadsheets, or information provided by Government program analysts. Provide data input into IEMP, PT, FOCUS (ESMD), Project Management Tool (PMT - developed by Ames Research Center), Funds Control System, Purchase Requests, and WIMS. Maintain proficiency with computer graphics software being used by the Government programs/projects to generate charts and reports and with the data sources that serve as the basis for the charts and reports.
c. Upon request, the Contractor shall provide training on SAP and SAP Business Warehouse to Government program analysts to help provide more efficient reporting to programs and projects.

2.2.1: Deliverables:

a. Monthly Management Report—the Contractor shall provide project financial and workforce reports and submit formatted spreadsheets by the 3rd business day of every month.
   i. Financial actuals in total and by cost element (procurement, labor, travel and pools)
   ii. Workforce actuals - Civil servant (hours, FTE, and overtime/compensatory time)
b. Provide program analysis support for the project by the 10th day of every month
   i. Management reports such as Center Management Council (CMC), Technical, Cost, Schedule Review (TCSR), Integrated Center Management Council, ESOD Monthly

Management Report (MMR)

ii. Earned value reports and analysis, as needed

c. Provide program analysis support for the project by the 15th day of every month

i. Major procurement actuals – 3-month moving costing averages, 533 actuals and analysis, and other requirements as defined by the project.

d. Provide program analysis support for weekly and monthly meetings and teleconferences, as necessary to meet critical deadlines or to provide intermediate data (versus monthly data) to assess project performance at the particular point in time.

2.3 Sub-Task 3 – Integrated Cost/Schedule/Technical Analyst and Earned Value Management Implementation Support

a. The Contractor shall serve as an expert in integrating cost, schedule and technical data for projects. The Contractor shall provide support to the Exploration and Space Operations Directorate and Flight Projects Directorate in developing the necessary spreadsheets and databases to implement an integrated approach to project management which will enable the Center to implement Earned Value Management. The Contractor shall establish and meet deadlines based on Government priority and established work request procedures when accepting work. The Contractor shall respond to ad hoc customer inquiries. Advanced use of standard business software applications such as Excel, Access, and Project is required for doing in-depth analysis and presentation of project data. Knowledge or experience using NASA-unique applications SAP Business Warehouse, Workforce Integrated Management System (WIMS), Programmatic Template (PT), and Project Management Tool (PMT - developed by Ames Research Center), is desired. Knowledge of Crystal Reports XCelcius, Word, and Power Point, also desired. The Contractor shall enter, maintain, retrieve, analyze, and manipulate cost and schedule data and provide recommendations relating to LaRC programs and projects. Upon request, provide ESOD and FPD personnel with the ESOD and FPD training materials for the various earned value or integrated cost/schedule/technical tools or processes.

b. The Contractor shall work with program analysts, risk analysts, cost analysts, and schedule analysts to assist in the development of an integrated cost, schedule and technical baseline for FPD/ESOD projects. The Contractor shall lead the development of resource-loaded schedules for FPD/ESOD projects.

c. The Contractor shall design and develop integrated program control (financial, workforce, and schedule) reports for management officials on a daily, weekly, and monthly basis to be used for tracking budget plans, financial and overall performance (including Earned Value Management as required), workforce, variances, and budget trends and changes.

d. Until the Agency develops a fully-compliant EVM system, the Contractor shall provide guidance to projects in the implementation of earned value methods and techniques for measuring performance. The Contractor shall develop tools to produce earned value reporting integrating the SAP Business Warehouse actuals, Project Management Tool plans, and Microsoft Project schedules.

e. The Contractor shall develop tools to assist contract task monitors in the assessment of costs to date and appropriate spreading of costs.

f. The Contractor shall populate the Strategic Relationships' Office Basis of Estimate tool with data for each ESOD/FPD project to establish an initial time-phased resource plan. The Contractor shall work with the project to integrate this information into the appropriate schedule tools.

g. The Contractor shall provide periodic reporting of lessons learned.

2.3.1: Deliverables:

a. Monthly Management Report—the Contractor shall provide monthly reports statusing all activities associated with this task by the 10th of each month to include:
   i. Integrated summary report of all FPD/ESOD projects to include an integrated look at cost and schedule as well as **preliminary** analysis of any identified issues or concerns.
   ii. Earned value reports and analysis
   iii. Presentations, spreadsheets and databases and any other tools developed during the month. As tools mature, provide written and electronic documentation describing step-by-step how to use the tools as well as documenting the details of the tool.
b. Final Monthly Management Report – provide **final** analysis of any identified issues or concerns by the 15th of each month.
c. Provide quarterly report on lessons learned by the 20th of the month.
d. Provide FPD/ESOD management support for periodic (weekly, biweekly, monthly) meetings and teleconferences; attend other program and project meetings, as necessary.
   i. Analytical reports and "white papers"
   ii. Management bullet/presentation charts
e. As needed – Advise the management team on issues associated with the implementation of earned value management. Advise the management team on issues associated with the implementation of integrated project management.

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.3.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.3.2 Required date: Ongoing.

2.3.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

None

4. Other Essential Information:

(1) Travel may be required for each of the subtasks listed above. Each organization, program or project will provide funds to cover travel costs.

(2) 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 this contract.

(3) Special training may be required from time to time. The Technical Monitor will review the training

requirements and coordinate the requirements with the Contractor with the appropriate rationale.

(4) Attendance at conferences may be required from time to time. The Technical Monitor will review the conference agenda and coordinate the requirements with the Contractor with the appropriate rationale.

(5) Due to the schedule critical nature of project work, the Contractor may need to work beyond the normal work schedule with reasonable compensatory allowances to maintain personal safety and health.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

As defined at the subtask level.

6. Period of Performance:

Planned start date: TD1 ***June 1, 2009*** Completion date: 12/31/2009

7. NASA Task Management:

Technical Monitor (Required): Yvonne Dellapenta
M/S: 494 Phone: 864-2760

Other POC (Optional): Kathryn Ferrare
M/S: 494 Phone: 864-3776

TASK ORDER NUMBER: 027D2-NNL09AM17T Revision: 0 Change: 0 Date: May 29, 2009

Title: Alternate Spectrum Manager Support

1. Purpose, Objective, or Background (Optional)

The purpose of this task order is to provide an Alternate Spectrum Manager to support the LaRC Spectrum Manager. This task defines the requirements of the Alternate Spectrum Manager requirement.

The LaRC Spectrum Manager provides, maintains spectrum, supports emergency communications and enforces NTIA RF regulations for LaRC and reports directly to the Center Director. In addition, he monitors and resolves frequency interference issues. This is done by managing and coordinating with other government or commercial spectrum managers. The Spectrum Manager work is shared with other System Engineering projects and therefore there is a strong need for an Alternate Spectrum Manager support. Technical Direction 1 (6/29/09): Updates the initial task order start date to June 26, 2009 as issued by the CO on 6/26/09 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

This work is not a consistent hourly work week due to its nature of being on a request by request basis. However, over the year it is anticipated to be a 0.5 FTE (rough order of magnitude) for the Alternate Spectrum Manager requirement. Therefore the work schedule needs to be flexible. Some weeks will be forty hour work weeks while others may be only a few hours a week depending on incoming Radio Frequency Authorizations (RFA) requests, radio maintenance or interference issues.

2.1 (Requirement/subtask number one): The Contractor shall provide assistance to the LaRC Spectrum Manager according to the following requirements:

- 2.1.1 The Contractor shall provide LaRC RFAs
- 2.1.2 The Contractor shall provide pager service to LaRC employees and contractors. (Pagers are on hand and special caller IDs are coordinated with LaRC Security for transmission)
- 2.1.3 The Contractor shall develop and maintain LaRC Spectrum Management website.
- 2.1.4 The Contractor shall maintain radio maintenance spreadsheets.
- 2.1.5 The Contractor shall help coordinate with other government or commercial spectrum managers.
- 2.1.6 The Contractor shall help in the development of LaRC Emergency Satellite Communications system development.
- 2.1.7 The Contractor shall maintain NTIA Manual of Regulations & Procedures for Federal Frequency Management. (NTIA Red Book)
- 2.1.8 The Contractor shall maintain the LaRC Spectrum Database per the following:
  - 2.1.8.1 develop new RFAs
  - 2.1.8.2 provide RFA modifications
  - 2.1.8.3 delete old RFAs
  - 2.1.8.4 track and update five year review RFAs
  - 2.1.8.5 track and update RFA expirations
  - 2.1.8.6 maintain monthly data exchanges
  - 2.1.8.7 archive spectrum data

2.1.9 Deliverables and Schedule (Required): As noted above and below.

2.1.10 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

2.1.10.1 Contractor shall provide monthly LaRC RFA data exchange reports. See note 1 and 2.

2.1.10.2 Contractor shall provide monthly status of work conducted during the month. See note 1 and 2.

2.1.10.3 Contractor shall provide status on upcoming LaRC RFA five year review and expirations due. These reports are due end of June and end of September 2009.

2.1.10.4 Contractor shall provide pager spreadsheet updates along with monthly status. See note 1 and 2.

2.1.10.5 Contractor shall submit RFAs and temporary RF authorizations within two weeks from the time of a LaRC Spectrum Manager request. Meets: if met on time with only two late deliveries over the period of performance. Exceeds: If all are met on time.

2.1.10.6 Contractor shall update the NTIA Red Book within two weeks of receipt of new modifications from LaRC Spectrum Manager. Meets: if on time for new modifications after start of contract. Exceeds: if current backlog is caught up after one month of start of contract.

2.1.10.7 Contractor shall work with the LaRC Spectrum Manager on the format of reports and expectations of the above items 6.1-6.7. Meets: if completed within on month of start of contract. Exceeds: is completed within two weeks of start of contract.

2.1.10.8 Contractor shall attend Agency Spectrum meetings up to three a year with each no more that five business days long which are within CONUS. Meets: if one is met. Exceeds if more than one are attended.

2.1.10.9 Contractor shall act as alternate POC when LaRC Spectrum Manager is not available. Meets: No cited missed contacts within 24 hours of receipt of email or phone notification. Exceeds**:** No cited missed contacts within same day of receipt of email or phone notification.

2.1.10.10 Contractor shall take SXXI and EL-CID training at the next available class opening. Meets: Successful completion of training (certificate obtained). Exceeds: Shows successful implementation of SXXI database and data exchange on next RF authorization request.

2.1.10.11 Contractor shall have a LaRC Spectrum website. Meets: if completed before the end of period of performance. Exceeds: if completed within three month from start of contract.

2.1.10.12 Contractor shall archive the LaRC RF database every three months. Meets: if met on time. Exceeds: if done once a month.

Note 1: Status reports can be combined into one report. All monthly reports are due the COB the last Friday of the month

Note 2: 'Month' is defined here per business days, Monday through Friday. One month is 20 business days.

2.n Sub-Task - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

3.1 The Government will provide specialized training, associated manuals, software, LaRC RF databases,
pagers and pager tracking spreadsheets. Contractor shall provide computer and be on LaRC network to host and run software. Contractor shall provide a cell phone contact number.

4. Other Essential Information:

4.1 Access to Sensitive or ITAR Data: *Not required.*

4.2 Contractor is required to take Spectrum XXI database training and certification and EL- CID (Equipment Location-Certification Information Database).

4.3 Contractor has to be a U.S. citizen and access to LaRC.

4.4 RF experience is preferred but not required.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): N/A

6. Period of Performance:

Planned start date: [TD1] ***June 26, 2009*** Completion date: September 30th 2010

7. NASA Task Management:

Technical Monitor (Required): **Kevin G. Vipavetz**

M/S: 253 Phone: 757-864-3817

Other POC (Optional):

M/S: **N/A** Phone: **N/A**

TASK ORDER NUMBER: 078D3-NNL09AM18T Revision: 0 Change: 0 Date: June 4, 2009.

Title: Environmental Testing of High Temperature Materials and Thermal/Structural Testing of Airframe/TPS Components

1. Purpose, Objective, or Background (Optional)

The Structural Mechanics and Concepts Branch (SMCB) of the RTD has the responsibility to assist NASA Projects with thermal, structural, and thermal-structural design, analysis and testing required to develop advanced technologies in support of the NASA missions for exploration and ongoing aeronautics research.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) to this task order. The Government will clarify requirements for each requested subtask activity through NOC's. These requirements will include the specific schedule, expected deliverables (including format), and other clarifications as needed. See NOC designated item(s) and description below.

2.1 Subtask 1. Hypersonics Project Support

The Contractor shall provide test support to the Materials and Structures Discipline of the Hypersonics Project. Test support shall include evaluation of materials in the Hypersonic Materials Environmental Test System (HyMETS), characterization of thermal performance of advanced insulation materials in the B1148 and B1250 thermal vacuum chambers, and assessment of structural performance of hot structure/TPS concepts. Test support shall include developing test plans and attending test planning meetings and telecons as required, identifying acquisition or enhancement of laboratory equipment needed to accomplish testing, performing shakedown of test equipment and setup, performing tests, and documenting results in test reports. The Contractor shall provide test support for the following:

A. HyMETS: Assist in the shakedown and environmental (flow conditions) mapping after new chiller installation, assist in control system and data acquisition software modifications, perform materials screening tests on CMC's from different vendors and with different coatings and new ablators.

B. Thermal Vacuum Chamber: Assist in shakedown of B1148 thermal vacuum chamber, assist in thermal performance characterization of panels in B1148 and B1250 thermal vacuum chambers

C. Structural Testing: Identify and perform sub-element tests to establish failure criteria for the SITPS panel fabricated by ATK COIC.

2.1.1 Milestones (Optional): N/A

2.1.2 Deliverables and Schedule (Required):

- Monthly technical progress reports - Monthly through 9/30/09
- Test Plans, Test Data, and Test Reports – Ongoing 9/30/09

2.2 Subtask 2. (NOC) Structural Mechanics and Concepts Ad Hoc Support

A. The Contractor shall conduct thermal, structural and/or thermal-structural analyses and design studies of advanced structural 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 NASA 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 and material systems will be considered. Thermal and structural analyses are required to size and compare these 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.

B. 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.

C. The Contractor shall, as specified in individual NOC'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, design test fixtures, 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.

2.2.1 Milestones (Optional): N/A. (Primarily surge activities associated with launch systems, upper stages of launch vehicles, crew module, launch abort systems, landing systems, on planet surface systems, and Shuttle operations.)

2.2.2 Deliverables and Schedule (Required): (NOC) Note: Specific deliverables and due dates will be clarified in the NOCs

a. Finite element models and results suitable for presentation.
b. Short written reports of design studies, analyses and weight trades of various concept studies. Detailed weight statements for integrated airframe concepts, algorithms for estimating weights of non-modeled structural features, and written reports of analytical results.
c. Analyses, test plans, and instrumentation layouts in electronic and printed form.
d. Test specimens and hardware to the appropriate testing laboratory
e. Test support as clarified in the NOC.
f. Progress reports documenting the results in electronic form.

Technical Subtask Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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.

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:
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.

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.

All subtask elements are completed and all deliverables are met ahead of schedule

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Contractor will be provided access to UNIX workstations and associated CAD/CAE software, 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.

Test specimens

Test specimen instrumentation

Specialized measurement [R6] and 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 available)

4. Other Essential Information:

- All Langley safety procedures shall be followed.
- 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.
- **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.

Dissemination of significant results through periodic technical interchange meetings at other NASA centers and/or international forums, along with associated travel, may be required as appropriate.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

Secret clearances are not anticipated but all contract staff should be US citizens and have passed an NAC. LaRC ADP requirements apply. US Citizenship is required because contractor personnel will be exposed to ITAR information.

6. Period of Performance:

Planned start date: July 15, 2009 Completion date: December 31, 2010

7. NASA Task Management:

Technical Monitor (Required): Kim S. Bey
M/S: 190 Phone: 757-864-1351

TASK ORDER NUMBER: 013E4-NNL09AM19T Revision:1 Change: 0 Date: January 11, 2010

Title: **Tool Development for HALE UAV Systems Analysis**

1. Purpose, Objective, or Background (Optional)

The Aeronautics Systems Analysis Branch has repeatedly been asked to provide High Altitude Long Endurance (HALE) Unmanned Aerial Vehicle (UAV) systems analysis. Recent examples include the feasibility study for the UAV sector under the Vehicle Systems Program, the ICESat mission quick-look study for the Systems Engineering Directorate, the hurricane hunter mission study for the Science Directorate, and, most recently, the Vulture mission analysis for DARPA. A research-level HALE UAV analysis capability has been developed over the past few years as a by-product of supporting these studies, but it is limited. This capability currently has elements that are proprietary and cannot be shared outside of NASA. In addition, there are many unmet modeling requirements, such as the need to model sun-tracking orbit patterns for solar aircraft and modeling of specific payloads. The current analysis capability also needs to be further automated to increase efficiency and accuracy. An improved, distributable HALE UAV analysis tool is needed to support future HALE analysis within and outside of NASA. Ultimately the ASAB desires to have a production-level analysis capability suitable for transition to other users. Key characteristics would include comprehensive documentation; a user friendly interface; the ability to analyze existing configurations as well as determine design sensitivities and conduct "what if" analysis; variable fidelity analysis components allowing the appropriate level of fidelity to be selected for the problem at hand; cost analysis, both acquisition and life cycle cost; fleet sizing and operational analysis; mission simulation including payload performance and wind impacts.

The importance of enhanced analysis capabilities in this area has been recognized by the SACD Tools and Methods Working Group, which has provided funding to begin the development effort.

Revision 0 (6-05-2009): Task origination.

Revision 1 (1-11-2010): Adds additional requirements in section 2.1 as Task 3 and extends period of performance nine months to 12/31/2010 (see [R1] below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Technical Tasks 1, 2 and [R1] ***3***:

1. The Contractor shall establish a roadmap for development of a comprehensive, non-proprietary Solar-Electric HALE systems analysis capability by performing the following requirements:
    a. Define and characterize the tool or suite of tools required to meet ASAB's ultimate vision for Solar-Electric HALE systems analysis capability.
    b. Survey and assess currently available tools and methods (in-house, non-proprietary external, and COTS)
    c. Identify gaps in currently available tools and methods relative to capabilities defined in 1a.
    d. Draft a roadmap to progress from the current state to the desired future capability in a series of development spirals. Roadmap shall have detailed plans for the development of the Spiral 1 capability, and enough detail for follow-on spirals to support development of future statements of work.

2. The Contractor shall complete development of the Spiral 1 capability. Based on the roadmap established in Task 1, conduct high priority tool development activities to achieve Spiral 1 capability as defined in the roadmap. Specifics of this task to be determined by results of Task 1.

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

3. Development of Spiral 2-4 capability

   a. Develop Spiral 2 Environmental Component: Winds and Energy Available
   The contractor shall complete development of the Spiral 2 capability, including algorithms for the determination of the range and limits of possible vehicle orbits, given the historical wind velocities and projected vehicle performance. The influence of the daytime objective to maximize the rate of energy collection and the nighttime objective to minimize energy expenditure shall be compared in assessing vehicle orbits. The contractor shall integrate this capability into the Spiral 1 tool and perform verification and validation. Spiral 2 will then be a fully integrated HALE UAV design and analysis tool incorporating work done for Spirals 1 and 2.

   b. Develop Spiral 3 Environmental Component: Shadows and Vehicle Geometry Component
   The contractor shall complete development of a shadow calculation utility which accounts for temporal and spatial variations, for a given vehicle geometry. This utility shall be validated utilizing a known geometry configuration that demonstrates the anticipated challenges for a Vulture-type vehicle. The contractor shall integrate this capability into the Spiral 2 tool and perform verification and validation of the integrated tool. Spiral 3 will then be a fully integrated HALE UAV design and analysis tool incorporating work done for Spirals 1, 2, and 3.

   c. Develop Spiral 4 Operations Component: Off-station Penalties and Recovery
   The contractor shall complete development of off-station penalty and recovery algorithms. This development activity will require working with the NASA customer to define mission off-station penalties and recovery strategies. The contractor shall integrate this capability into the Spiral 3 tool and perform verification and validation of the integrated tool. The contractor shall also create a global winds database suitable for simulation and integrate this capability into the Spiral 3 tool and perform verification and validation of the integrated tool. Spiral 4 will then be a fully integrated HALE UAV design and analysis tool incorporating work done for Spirals 1, 2, 3, and 4.

   d. The contractor shall utilize (subject to availability) Vulture Phase II Full Scale Demonstrator (FSD) and Objective System (OS) concepts as modeling test cases to assist with the development of Spirals 2-4. The contractor shall also allocate time, not to exceed 10% of the total effort, to be utilized for unforeseen or quick turnaround requests from the NASA or DARPA customer.

***** End [R1] block addition*****

2.1.2 Deliverables and Schedule (Required):

Task 1: Written report including: description of ultimate goal of development activity in terms of high-level requirements and overall vision for the future capability, discussion of results of tool survey and assessment, description of current capability gaps, and detailed explanation and justification of the development roadmap. Spiral 1 requirements and detailed development schedule shall be included.

Task 1 written report due 9/30/09.

Task 2: Technical briefing provided to NASA that includes a presentation of the Spiral 1 capabilities, a summary of the work performed to achieve those capabilities, and a demonstration of use of the Spiral 1 tool(s) on a relevant example problem. Deliverables also shall include the source code and executables required to utilize Spiral 1, and documentation (i.e., users manual).

Task 2 final briefing conducted prior to 3/31/10.

Task 1 & 2: Monthly status reports indicating progress to-date, planned near term activities, technical issues, and resource status. Status reports shall be no more than one page in outline format, and shall be discussed at a monthly status meeting with the technical lead and other interested parties.

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

Task 3

a) Monthly status indicating progress to-date, planned near term activities, technical issues, and resource status. Status reports shall be no more than one page in outline format, and shall be discussed at a monthly status meeting with the technical lead and other interested parties.

b) Technical briefing provided to NASA that includes a presentation of the Spiral 2 capabilities, a summary of the work performed to achieve those capabilities, and a demonstration of use of the Spiral 2 tool(s) on a relevant example problem. Deliverables also shall include the source code and executables required to utilize Spiral 2, and documentation (i.e., users manual). **Final briefing shall be conducted prior to 6/30/10**.

c) Technical briefing provided to NASA that includes a presentation of the Spiral 3 capabilities, a summary of the work performed to achieve those capabilities, and a demonstration of use of the Spiral 3 tool(s) on a relevant example problem. Deliverables also shall include the source code and executables required to utilize Spiral 3, and documentation (i.e., users manual). **Final briefing shall be conducted prior to 9/30/10**.

d) Technical briefing provided to NASA that includes a presentation of the Spiral 4 capabilities, a summary of the work performed to achieve those capabilities, and a demonstration of use of the Spiral 4 tool(s) on a relevant example problem. Deliverables also shall include the source code and executables required to utilize

Spiral 4, and documentation (i.e., users manual). **Final briefing shall be conducted prior to 12/31/10**.

***** End [R1] block addition*****

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets Minimum Performance: Deliverables as described and on time.

Exceeding Minimum Performance: Deliverables on time, plus added value in terms of clarity, quality, and innovativeness.

2.n Sub-Task n - Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Access to and/or use of the following will be provided by NASA to the Contractor as required for task performance:

Access to government tools relevant to this activity (e.g., SAAC, arraysum, VSP, AV-HALE, GT-HALE). STK and ModelCenter software will be provided.

4. Other Essential Information:

The Contractor will participate in appropriate technical conferences/short courses to maintain cognizance of new approaches and to refresh skills, as needed, to support the requirements of this task order in coordination with the Technical Monitor.

NOTE: The Contractor shall place no restrictions on NASA's use or distribution of the models/codes produced under this contract nor distribute them to other parties without NASA's permission.

Note: These codes will only be used for performing the work under this contract and cannot be used for any other purpose or distributed without the permission of NASA, Langley. The Contractor is required to sign a Software Usage Agreement.

5. Security Clearance:

6. Period of Performance:

Planned start date: July 1, 2009 Completion date: R1 ~~March 31, 2010~~ ***December 31, 2010***

7. NASA Task Management:

Technical Monitor (Required): Jeffrey K. Viken
M/S: 442 Phone: 757-864-2875

Other POC (Optional): Mark Guynn
M/S: 442 Phone: (757) 864-8053 Mark.D.Guynn@nasa.gov

Other POC (Optional):

TASK ORDER NUMBER: 028D2-NNL09AM20T Revision: 2 Change: 0 Date: December 4, 2009

Title: ICESat-II and STORM DTO Software Engineering Support

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to provide software engineering support to the ICESat-II Project.

Technical Direction 1 (7/21/09): Updates the initial task order start date to July 20, 2009 as issued by the CO on 7/20/09 (see [TD1] below, Section 6).

Revision 1 (9/3/09): Extends the period of performance 3 months to December 31, 2009 in continuation of NASA's support due to complexity of work. Note: For planning purposes both subtasks 2.1 and 2.2 should be considered extended, but funding is available for only subtask 2.2 at this point. Contractor coordination to determine available funding is required to perform requirements of subtask 2.1. (See [R1] below.)

Revision 2 (12/4/09): Extends period of performance four months to May 1, 2010 with updated schedule due to the workload being greater than anticipated, and updated NASA Task Management info (see [R2] below).

2. Description of the Work to be Performed:

2.1 (Requirement/subtask number one):

The contractor will be given a physics model of a laser amplifier and needs to generate the code in Fortran that describes the model.

The Contractor shall develop, and test FORTRAN code for assigned workload.

No laser experience needed. Full time support anticipated from now until end of [R1]~~September~~ [R2]~~December 2009~~ ***May 1, 2010***. [R1>]See note in Revision 1 Synopsis above.[<R1]

2.1.1 Deliverables and Schedule (Required):

- FORTRAN code for assigned workload.
- FORTRAN test report(s) for assigned workload.
- Monthly activity report, due by 5th business day each month.

2.1.2 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Software tasks are completed on schedule, and products contribute to a successful acceptance review.

Exceeds: Software tasks are completed ahead of schedule, and products contribute to a successful acceptance and result in project compliments.

2.2 (Requirement/subtask number two):

The Contractor shall develop and test C code for a PowerPC running the VxWorks Real-Time Operating System. The software application shall establish Ethernet Communications with the Shuttle Payload General Support Computer (PGSC) over a 10BaseT network connection. The code shall be capable of receiving commands, collecting telemetry, and forwarding telemetry that also needs to spawn off the data retrieval. Overall, the control routines shall be capable of controlling the modes for the data recorder – enabling/disabling different interrupts.

2.2.1 Deliverables and Schedule (Required):

- C code, documentation, procedure, and loading instructions, due R1~~September~~ R2~~December 14, 2009~~ ***May 1, 2010***
- C code test report(s), due R1~~September~~ R2~~December14, 2009~~ ***May 1, 2010***
- Monthly activity report, due by 5th business day each month.

2.2.2 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Software tasks are completed on schedule, and products contribute to a successful acceptance review.

Exceeds: Software tasks are completed ahead of schedule, and products contribute to a successful acceptance and result in project compliments.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Desk and phone will be provided by the Flight Software Systems Branch, in close proximity to the ICESat-II project team (bld 1202)

4. Other Essential Information:

TDY is not currently anticipated, however, contractor should be willing to accept TDY requests if requirements change.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

None

6. Period of Performance:

Planned start date: TD1 7/20/2009 Completion date: R1~~9/30/2009~~*
R2~~12/31/2009~~
5/1/2010

*This could lead to more ICESat-II work in FY10.

7. [R2]NASA Task Management:

Technical Monitor (Required): Kathryn Stacy
M/S: 472 Phone: x46719

Alternate Technical Monitor: David Haakenson
M/S: 472 Phone: x41797

TASK ORDER NUMBER: 014E4-NNL09AM21T Revision: 1 Change: 0 Date: September 30, 2009

Title: Revolutionary, Airborne, Distributed Air Traffic Control & Management Design and Analysis Techniques

1. Purpose, Objective, or Background (Optional)

The purpose of this work is to demonstrate the ability to analyze revolutionary approaches at distributed air traffic control & management using the Traffic Manager (TMX) airspace simulation tool. Revolutionary approaches include (*but are not limited to):* airborne conflict prevention, strategic conflict detection and resolution (CD&R), traffic flow management (TFM) integration, and others. Each approach must be successfully demonstrated as detailed in the Deliverables section of this task.

Technical Direction 1 (6/29/09): Clarifies conditions of GFI (see [TD1] below, Section 3).
Technical Direction 2 (7/2/09): Further clarifies conditions of GFI (see [TD2] below, Section 3).
Technical Direction 3 (8/24/09): Updates the initial task order start date to August 19, 2009 as issued by the CO on 8/19/09 (see [TD3] below, Section 6).
Revision 1 (9/29/09): Extends the period of performance 2.5 months to September 30, 2010 to allow completion of work that started later than anticipated (see [R1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall perform the following subtasks:

a. Integrate Conflict Prevention (CP) system based on the Airborne Coordinated Conflict Resolution and Detection (AcCORD) algorithm (provided by NASA), and test/validate in comparison with current TMX Predictive Airborne Separation Assistance System (P-ASAS) performance.
b. Research the feasibility of simulating the performance of the strategic, intent-based conflict detection and resolution (CD&R) capability *(a genetic algorithm (GA))*, currently employed by NASA's Airborne Operations Planner (AOP), using either a computationally simpler algorithm, or the actual GA extracted from the AOP in a modular form (each algorithm provided by NASA.)
c. Research the feasibility of integrating a traffic flow management (TFM) concept (provided by NASA) with the CD&R capability described in 3.b. above.
d. Provide technical consultancy to LaRC researchers to support development of
   i. a parallel processing capability using TMX
   ii. GIVE and TAKE capabilities to exchange control of simulated aircraft between TMX and another flight simulator (e.g. ASTOR)
   iii. Modeling the effects of speed brakes on equipped aircraft within TMX
   iv. Resolution of display refresh issues with TMX
   v. Transfer of route waypoint constraints among different air routes; investigation of cause, proposed mitigation approach, and possible implementation of mitigation approach required.
   vi. Mitigating impact of "midnight rollover" on simulation execution
e. Research, develop and document a set of pilot model (PM) rules for tactical maneuvering (account for information provided via the conflict prevention system developed under 3.a. above)
   i. Research and develop a set of operational rules for re-connecting to an active route after resolving a conflict
   ii. Research and develop a set of operational rules to choose between multiple strategic conflict resolutions based on route efficiency and/or flexibility preservation.
   iii. Research and develop an approach for re-routing around weather in TMX
   iv. Research and develop pilot model prototyping capability in TMX to define pilot model rules for Aircraft Simulation for Traffic Operations Research (ASTOR) implementation (perhaps including the interoperability of tactical and strategic CD&R functionality)
   v. Explore use of tactical CD&R in scenarios with a short time until first loss of separation (FLOS) - assuming strategic CD&R failed to resolve the conflict. Explore pilot model rules corresponding to the transfer of control from strategic to tactical over a range of times prior to FLOS.
f. Explore the limits of vertical, state-based CD&R, and Conflict Prevention

i. Challenge assumptions of constant ground speed, climb angle, and other relevant parameters
ii. Design scenarios that explore limits of operability
iii. Identify issues related to operability limits, and possible solutions
iv. Test scenarios, analyze and report findings
v. Investigate cause of - and propose solution to - intermittent condition where state-based conflict resolution "chatters" between different resolution maneuver options (e.g. "turn-left", "no turn-right" ...)
   1. Determine cause of "chattering" condition using pilot model rules
   2. Develop, test and document mitigation approach(s)

j. Explore the integration of weather data into airspace simulation
   i. Evaluate new weather data types (from NASA) for possible integration in TMX
   ii. Evaluate display options for new weather data (e.g. radar & nav displays)
   iii. Outline a recommended process for integrating weather data into the TMX airspace simulation capability.

2.1.1 Milestones (Optional): N/A

2.1.2 Deliverables and Schedule (Required): The Contractor shall coordinate deliverables schedule with the Technical Monitor (See below.)

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting") (See table below.)

Table of Detailed Deliverables:

SUB-TASK	DELIVERABLE	TARGET SUCCESS CRITERIA (Meets)	COMMENTS for planning purposes
a.	1. Written section in the informal final report documenting results of the performance comparison between AcCORD-based conflict prevention (CP) system and current P-ASAS CP system 2. TMX source-code updates with AcCORD-based CP system implementation 3. Section in the informal final report that concisely describes ACCoRD integration in TMX for TMX User's Guide.	1. Comprehensive, clear & concisely written description of: comparison approach, comparison results focusing on essential technical performance factors, and summary of performance related issues. 2. Updated TMX source code that functions properly and reliably 3. Comprehensive, clear & concise narrative describing the ACCoRD integration within TMX	
b.	1. Develop approach for implementing strategic CD&R functionality within TMX (either simplified CD&R algorithm or extracted GA.) 2. Implement strategic CD&R functionality in TMX.	1. Comprehensive, clear & concisely written section in the informal final report that documents the approach, implementation and verification of the strategic	Strategic CD&R capability will very likely be based on the computationally simpler ACCoRD algorithm, however integrating the more

	3. Verify strategic CD&R functionality in TMX	CD&R functionality in TMX	complex GA remains a less-likely possibility.
c.	1. Develop approach for strategic CD&R/TFM integration within TMX (either simplified algorithm or extracted GA.) 2. Implement strategic CD&R /TFM integration within TMX. 3. Verify successful integration of strategic CD&R/TFM in TMX	Comprehensive, clear & concise written section within the informal final report documenting the approach, implementation and verification of the integrated operation of strategic CD&R with TFM functionality in TMX	TFM control actions will consist primarily of departure control, airborne re-routing, and airborne holding updates to the flight schedule
d.i.	Technical consultancy related to parallel processing TMX	Research questions answered effectively, efficiently & in timely fashion	Not to exceed (NTE) 40 hrs level of effort (LOE)
d.ii.	Technical consultancy related to GIVE/TAKE capability	Research questions answered effectively, efficiently & in timely fashion	NTE 100 hrs LOE
d.iii.	Technical consultancy related to speed brake modeling in TMX	Research questions answered effectively, efficiently & in timely fashion	NTE 40 hrs LOE
d.iv.	Technical consultancy related to display refresh issues in TMX	Research questions answered effectively, efficiently & in timely fashion	NTE 40 hrs LOE
d.v.	Technical consultancy related to route waypoint constraints.	1. Work collaboratively with LaRC researcher to determine cause of waypoint problem 2. Propose mitigation approach options 3. Implement mitigation approach in TMX, and verify proper operation	NTE 80 hrs LOE to determine cause of problem, propose mitigation approaches and implement solution within TMX – in the order prescribed.
d.vi.	Technical consultancy related to "midnight rollover" issue in TMX.	1. Work collaboratively with LaRC researcher to determine cause of "midnight rollover" problem 2. Propose mitigation approach options 3. Implement mitigation approach in TMX, and verify proper operation	NTE 80 hrs LOE to determine cause of problem, propose mitigation approaches and implement solution within TMX – in the order prescribed.
e.i.	1. Successful demonstration of the effectiveness of PM operational rules for re-connecting to active route after resolving a conflict 2. Written section within the informal final report, documenting the set of PM	1. Effectiveness will be assessed based upon re-connect reliability, and distance/time efficiency of routing 2. Quality of rules	

	operational rules together with corresponding assumptions	documentation will be based on comprehensiveness, clarity and conciseness	
e.ii.	1. Develop an approach for choosing between multiple strategic conflict resolutions. 2. Implement the approach 3. Verify performance of the approach 4. Written section within the informal final report documenting the approach as implemented.	1. Approach shall be approved by TM prior to implementation 2. Implementation will be assessed for efficiency within TMX 3. Performance will be assessed based upon effectiveness and reliability relative to the approved approach. 4. Quality of documentation will be assessed based upon comprehensiveness, clarity and conciseness.	
e.iii.	1. Develop an approach for re-routing around weather in TMX 2. Implement the approach 3. Verify performance of the approach 4. Written section within the informal final report, documenting the weather re-routing approach	1. Approach shall be approved by TM prior to implementation 2. Implementation will be assessed for efficiency within TMX 3. Effectiveness will be assessed based upon re-routing reliability, and distance and/or time efficiency of re-routing 4. Quality of documentation will be based on comprehensiveness, clarity and conciseness	
e.iv.	Written section within the informal final report, which uses the pilot model (PM) rules developed in e.i through e.iii above, to outline a general approach for using TMX to prototype new PM Rules for ASTOR station implementation	Quality of documentation will be based on comprehensiveness, clarity and conciseness	
e.v	1. Written section within informal final report documenting: control transfer options considered, between tactical & strategic CD&R in scenario(s) with a short time before FLOS. Include a list of all relevant control parameters (tactical & strategic.) 2. Modifications to TMX source code to allow efficient changes to each of the	1. Quality of documentation will be based on comprehensiveness, clarity and conciseness 2. TMX modifications will be assessed based on proper functionality, and ease of operation relative to modifying control transfer	

	relevant control transfer parameters to support research experiments exploring optimal transfer approaches.	parameters to support research experiments	
f.i.-iv.	1. Document scenario descriptions that explore operability limits related to vertical, state-based CD&R and Conflict Prevention 2. Test scenarios in TMX, analyze test results, and report results related to observed performance limits	1. Comprehensive, clear & concise written description in the informal final report, of scenarios that fully explore the limits of state-based CD&R and Conflict Prevention. 2. Comprehensive, clear & concise written section in the informal final report documenting test results (full scenario set)	If unable to fully explore operability limits scenarios, then highest priority scenarios should be addressed first.
f.v.	1. Develop an approach for eliminating the "chattering" condition in collaboration with NASA formal methods researchers 2. Implement the approach 3. Verify performance of the approach 4. Written section within the informal final report, documenting the chattering condition mitigation approach	1. Approach shall be approved by TM prior to implementation 2. Implementation will be assessed for efficiency within TMX 3. Effectiveness will be assessed based reliable elimination of chattering condition 4. Quality of documentation will be based on comprehensiveness, clarity and conciseness	This work will be collaborative with formal methods researchers at NASA to verify mitigation maintains formal correctness of tactical CD&R
j.i. – iii.	1. Written section within the informal final report, documenting the recommended approach for integrating weather in TMX. Approach should consider the nature of weather data available, and the simulation objectives associated with weather avoidance re-routing.	1. Clear, concise & comprehensive technical report describing approach to integrating weather into TMX simulation, specific implementation steps required, and functional verification approach once implementation is complete. 2. If implementation and verification were completed, provide updated version of TMX containing the weather simulation functionality.	

TMX Source code modifications related to each deliverable above will be provided to NASA at the Task Completion Meeting.

Reports and Teleconferences:

Quarterly Progress Report shall be provided three months from the date of task issuance, and subsequent reports three months from the prior quarterly report Quarterly report should be an informal, written progress update of work, by subtask.

Informal Final Report shall be provided at the Task Completion Meeting and the Contractor shall coordinate with Technical Monitor (TM) to schedule the exact date.

Teleconferences shall be initiated by either the contractor or TM on an as-needed basis, and convened at mutually agreeable times and dates.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

TD1>Access to the following items may be provided to the Contractor as needed for the sole purpose of performing the requirements of this task order:<TD1

a. ACCoRD CD&R Algorithm (C++ version)
b. ACCoRD – based CP Bands (C++ version)
c. TD2>Simplified representation of, or interface specification for, airborne separation assurance concept<TD2
d. TFM Concept and accompanying software code TD2>or interface specification<TD2

4. Other Essential Information:

Travel:

Task Kick-off Meeting will be coordinated between the contractor and NASA TM to take place shortly after task issuance. The purpose will be to clarify all subtask issues to ensure a common understanding of both contractor and NASA expectations. The kickoff meeting will be held at LaRC and initiated by NASA at a mutually agreed upon date and time. The contractor shall travel to LaRC for the task kick-off meeting.

Task Completion Meeting will be coordinated between the Contractor and NASA TM to take place at the end of the defined period of performance (approximately one year after task issuance.) The purpose will be for the Contractor to present the results of the completed work scope defined above. The task completion meeting will be held at LaRC and initiated by NASA at a mutually agreed upon date and time. The contractor shall travel to LaRC for the task completion meeting.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: [TD3] August 19, 2009 Completion date: [R1] ~~July 15, 2010~~ ***September 30, 2010***

7. NASA Task Management:

Technical Monitor (Required): **Kurt W. Neitzke** kurt.w.neitzke@.nasa.gov

M/S: 442 Phone/Fax: 757-864-4917/6306

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 029D2-NNL09AM22T Revision: 1 Change: 0 Date: December 16, 2009

Title: Software Engineering Support for STORRM Software Application (SSA)

1. Purpose, Objective, or Background (Optional)

The purpose of this task is to provide software engineering support for the Sensor Test for Orion Relative Navigation Risk Mitigation (STORRM) Development Test Objective (DTO) Project that will fly on STS-134, currently scheduled for July 2010, by designing, developing, integrating, testing, and documenting the software for the Shuttle on-board Payload General Support Computer (PGSC) and the Ground Operations System (GOS) software.

The primary objective of the STORRM DTO is demonstrate new docking technologies by **collecting and recording data** from the Orion relative navigation sensors during Shuttle rendezvous, proximity operations, docking and undocking to the ISS **for post-flight processing and analysis**. This DTO is being performed to evaluate relative navigation performance to mitigate the risks carried by the Orion Project. Protoflight units of two of the three planned Orion Relative Navigation Sensors (Vision Navigation Sensor (VNS) and Docking Camera) will be located in the Orbiter Payload Bay and will collect data during specified flight phases. An avionics system (being developed at LaRC) will be located in the Orbiter Payload Bay and will interface to the sensors and contain the data storage memory boards. The avionics system will also interface to a Shuttle On-board Payload General Support Computer (PGSC) that will be located in the Crew Cabin Mid Deck. The PGSC will be used for command, control, and communication functions with the Protoflight sensors via the avionics system. Custom software will be designed and developed for the PGSC (on Windows XP) to command and control the sensors and display health and status and limited measurement data from the sensors. The STORRM software application will get shuttle operating range information from the WinDecom telemetry stream for autonomous commanding of the sensors. Sequential Still Video link will be used for displaying sensor health and status and limited measurement data to the DTO team on the ground. While docked at ISS, limited snapshots of data will be pulled off the data recorder and down linked via Orbiter Communications Adapter (OCA) to the ground to access sensor performance. Modifications to the sensor parameter table (for focus, exposure, contrast, brightness) may be uplinked via OCA.

Technical Direction 1 (8/18/09): Updates the initial task order start date to August 17, 2009 as issued by the CO on 8/17/09 (see [TD1] below, Section 6).
Revision 1 (12/16/09): Shortens the period of performance 8 months to January 31, 2010 (see [R1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

The Contractor shall design, develop, integrate, test, and document selected components of the STORRM Software Application (SSA) to command and control the sensors and display health and status and limited measurement data from the sensors, as well as the Ground Operations System (GOS) software application for data uplink and downlink functionality. The Contractor shall support functional testing at Langley with the Avionics Flight Unit and the Ball Aerospace & Technologies Corp (BATC) sensor emulators, and may be required to support final functional testing at BATC in Boulder, CO and testing in the Operations Processing Facility (OPF) at KSC. LabView (version 8.6) has been selected by the project as the software development environment. An incremental development approach will be utilized to develop this software. The software project is broken into a series of smaller deliverables called builds. The software phases (design, code, test, and integrate) are repeated for each build. The earlier builds can be used to implement

the more stable requirements, the higher priority requirements, and / or deal with the more significant risks early in the project.

2.1.1 Milestones (Optional):

- Deliver Avionics TestBed 2 (includes SSA build 2) to BATC per project schedule (September 10, 2009)
- Deliver Avionics TestBed 2 upgrade (includes SSA build 3) to BATC per project schedule (October, 27, 2009)
- Avionics Baseline Functional Test per project schedule (November 30, 2009)
- Avionics Final Functional Test per project schedule (December 18, 2009)
- Deliver Avionics Flight Unit (includes SSA Release Candidate) to BATC per project schedule (January 8, 2010)
- Risk Reduction Functional Testing at BATC per project schedule (February, 2010)
- Final Functional Testing at BATC per project schedule (March, 2010)
- Testing at OPF per project schedule (April, 2010)
- Final software for inclusion in Standard Load on all Flight PGSCs (April, 2010)
- STS-134 Flight per project schedule (July 29, 2010)

2.1.2 Deliverables and Schedule (Required):

- SSA software for each Build and Release Candidate version. (current schedule is as follows: Build 1 test completed – August 15, 2009, Build 2 integrated test complete – Sept. 10, 2009, Build 3 integrated test complete – October 27, 2009, Release Candidate integrated test complete – November 30, 2009)
- SSA test procedures and reports for each Build and Release Candidate version.
- SSA documentation for each Build and Release Candidate version.
- Monthly activity report, due by 5th work day each month.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: STORRM software application development and testing tasks are completed on schedule, and products contribute to a successful DTO.

Exceeds: STORRM software application development and testing tasks are completed ahead of schedule, and product contributes to a successful DTO.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: The Contractor shall perform software development and testing in the STORRM DTO Laboratory in B1202. The lab consists of :

- 4 PGSC laptops
- 4 Quatech RS422 PC Cards
- WinDecom installed on one of the PGSC laptops
- 2 Development PCs (Gateway), 2 4-Port RS422 Serial Cards
- 2 copies of Visual Studio Professional, 1 NI Developers Suite (has both LabView and LabWindows), 1 NI Vision Development Suite
- 5 NetGear Hubs

Desk and phone will be provided in close proximity to STORRM software team.

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):
ESD Certification, Laser Safety Certification.

6. Period of Performance:

Planned start date: [TD1] 8/17/2009 Completion date: [R1] ~~9/30/2010~~ ***1/31/2010***

7. NASA Task Management:

Technical Monitor (Required): Robert Kudlinski
M/S: 125 Phone: x46716
Alternate Technical Monitor: Kathryn Stacy
M/S: 472 Phone: x46719

TASK ORDER NUMBER: 079D3-NNL09AM23T Revision: 0 Change: 0 Date: July 29, 2009

Title: Impact Dynamics Analysis & Testing for Subsonic Rotary Wing Crashworthiness

1. Purpose, Objective, or Background (Optional) (Work performed under task order NNL07AM95T that is to be rolled out into this new task January 2010.)

NASA Langley Research Center's (LaRC) Structural Dynamics Branch (SDB) is currently working on several programs of national importance at the Langley Landing and Impact Research (LandIR) Facility, a 240-ft high gantry structure. The work in aircraft and rotary-wing crashworthiness has a history at the LandIR for over 30 years in aviation safety concepts for crashworthiness.

Computer technology has advanced whereby landing concepts, energy absorbing devices, and aircraft crash scenarios can now be simulated to minimize expensive full-scale testing. Computer codes such as LS-DYNA, developed for modeling car crashes and for containment of nuclear material, are now available for modeling a large variety of impact problems including airbags, anthropomorphic dummies, landings, aircraft crashes, and ballistic impacts such as that of the debris that brought down the space shuttle Columbia. Test data can be used to validate computer models over a given domain of initial velocities and impact conditions. Once validated, these computer models can be used to quickly expand the test envelope and to perform "what if" parameter studies.

2. Description of the Work to be Performed:

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

Specific projects and associated deliverables under this Task Order are described as sub-tasks below. For all of these sub-tasks, the primary deliverable shall be analytical impact and landing simulations of rotorcraft and aircraft using the nonlinear dynamic finite element code LS-DYNA. Subcomponents to be modeled include hybrid impact dummies and energy absorbing features such as airbags or crushable structure. In addition, sub-tasks may also require testing, analyzing experimental dynamic data (typically using Matlab or LabView software) and performing test and analysis correlations for model validation. Knowledge of the underlying physics of impact will be required to be able to build and understand the model output. This knowledge must include an understanding of dynamic impact behavior and strength of materials including material behavior in the linear, plastic, and failure regimes, for both metals and advanced composites. Analysis of digital data acquisition and manipulation including filtering shall be performed as part of the validation of computer models. Modeling of multi-terrain impacts such as impacts of aircraft and spacecraft onto hard surfaces, soft-soil, and water shall also be performed for these programs. Thus, simulations may require the use of Lagrangian, Eulerian, or Smooth Particle Hydrodynamic (SPH) formulations within LS-DYNA. Simulations of ballistic impact such as turbine fan blade containment or impact of debris such as occurred during the Columbia accident may also be required.

2.1 Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.1.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.1.2 Required date: Ongoing.

2.1.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

2.2 Crash Impact Analyses in Support of SRW Aeronautics Research: The Aeronautics research program within NASA was recently reshaped and reinvigorated to focus on foundational physics in a number of discipline areas across a wide range of flight regimes. One of these disciplines is Structures and Materials, which includes a sub-discipline topic of Rotorcraft Crashworthiness. This research program is funded under the Subsonic Rotary Wing (SRW) Aeronautics program. The crashworthiness research plan calls for work in multi-terrain impact simulations and development of a full-scale crash simulation of a composite prototype helicopter. Due to the highly integrated nature of this research with other program elements, it is difficult to specify discrete tasks with begin and end dates; however, for estimating purposes, the government anticipates that this sub-task can be accomplished by ~1 WYE of entry-level (<5 years experience) analyst support and ~1 WYE of early-career (5-10 years experience) support with analysis/test expertise

A. The Contractor shall create, run, analyze, post-process, and validate multiple LS-DYNA dynamic finite element models to predict the multi-terrain impact response of a composite deployable energy absorbing concept, as well as a full-scale finite element model of a composite prototype helicopter. Models may require updating or refinement such as re-meshing using MSC-PATRAN with the LS-DYNA preference or HyperWorks. Model files may also be required to be compatible with other codes (e. g., ABAQUS, NASTRAN). Most post-processing shall be done with LS-PREPOST or HyperWorks.

B. The Contractor shall validate the models through correlation with test data. Subsequent analyses may be required to determine the influence of modeling parameters on the level of test-analysis correlation. Model validation procedures shall conform to NASA Standard NASA-STD-7009, or other appropriate standards, as required.

C. The Contractor shall coordinate with test engineers and use test data from impacts onto multi-terrain to determine and/or modify the inputs for material models in LS-DYNA. Models include complex failure mechanisms and strain-rate effects. In addition, testing to fully characterize soft soil material properties for input into the LS-DYNA models will be required.

D. The Contractor shall create models using the MSC-PATRAN, [R2]HyperWorks and/or LSTC Pre-Post pre-processor using both explicit and implicit formulations of LS-DYNA. For example, the implicit version of LS-DYNA may be executed to correlate analytical predictions with quasi-static crush test data.

E. The Contractor shall support development of a full-scale finite element model of a composite prototype helicopter. The Contractor will interface with test personnel to determine aircraft loading, CG position, and other inertial properties. Material characterization testing may be required to provide input for the FE model. This model will be fully integrated including accurate physical

representations of the impact surface, landing or skid gear, airframe, subfloor, seats and attachment fittings, occupants, restraint systems, mass items such as rotor transmission and engines, other onboard devices such as cockpit airbags, cargo and restraint systems, and other external energy absorbing systems.

F. The Contractor shall support development of a shell-based finite element model of the composite-honeycomb, externally deployed energy absorber, including various cover options.

G. The Contractor shall become familiar with human occupant modeling approaches including ATB, GEBOD, MADYMO, and the occupant models embedded in LS-DYNA. In addition, the contractor shall become familiar with human injury criteria including Eiband whole body criteria, Head Injury Criteria (HIC), Dynamic Response Index (DRI), Brinkley Index, lumbar load criteria, etc. Finally, the contractor shall become familiar with relevant crash-related criteria including the Military Standard for Light Fixed and Rotary-Wing Aircraft (MIL-STD-1290); the DOD Joint Service Specification Guide for Crew Protection (JSSG-2010-7); requirements for emergency landing conditions as specified in the Federal Aviation Regulations (FAR) Parts 23, 27, and 29; and, aerospace performance standards for seat certification, as specified by the SAE.

H. (NOC) The Contractor may be requested to perform other analyses and associated design and testing activities to support this project.

2.2.1 (NOC) Deliverables and Schedule (Required):

Sub-Task Period of Performance: January 1, 2010 - December 31, 2010

(1) Monthly progress reports
(2) Reports summarizing technical approach, assumptions, loads, inputs and results for each test/analysis, including digital charts, graphs, animations, and jpeg pictures from LS-Post or other post-processing software such as Patran, HyperWorks, EnSight, Excel, MatLab, and Kaleidagraph.
(3) Test/Analysis correlation
(4) PATRAN and/or HyperWorks databases/session files, finite element models/input files of all models generated
(5) Analysis/test results files
(6) Powerpoint files summarizing test/analysis results in format determined by the customer
(7) Monthly planned vs. funded vs. actual financial report ($ and hours) for this sub-task.

2.2.2 Performance Metrics/Standards (Required - Meets, Exceeds):

Meets: Work completed accurately and on time as agreed upon for each NOC.

Exceeds:

(1) Work completed ahead of schedule, or suggestions by Contractor to make model development and/or analysis easier, more accurate, or more efficient.
(2) Superior documentation of work.
(3) Superior fidelity and accuracy of work.

3. Government Furnished Items:

Test specimens

Test specimen instrumentation

Access to NASA specialized structural analysis software, including MSC/NASTRAN, MSC/PATRAN and MSC/DYTRAN, LS-DYNA, LS-Post, IDEAS, HyperWorks, etc.

Computer CPU time for structural modeling and analyses

Office space

It is anticipated that the Contractor will provide standard ODIN workstations.

4. Other Essential Information:

US Citizenship is required because contractor personnel will be exposed to ITAR information.

Dissemination of significant results through periodic technical interchange meetings at other NASA centers and/or international forums, along with associated travel, may be required as appropriate.

Training and related travel may be required to support this task, to be coordinated with government as needs arise.

5. Security Clearance: None

6. Period of Performance:

Planned start date: January 1, 2010 Completion date: December 31, 2010

7. NASA Task Management:

Primary Technical Monitor: Karen Jackson
M/S: 495 Phone: 864-4147

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 030D2-NNL09AM25T Revision: 0 Change: 0 Date: August 6, 2009

Title: STORRM MLI Thermal Blanket

1. Purpose, Objective, or Background (Optional)

SCOPE

This PWS describes the requirements for the design, fabrication, delivery and installation of the NASA Sensor Test for Orion RelNav Risk Mitigation (STORRM) multiple layer insulation (MLI) thermal blanket and associated thermal protection hardware. There are two major deliverables from this effort: an MLI thermal blanket for the STORRM Avionics Enclosure and MLI connector covers.

Background

In accordance with applicable data rights clauses, the Government will have Unlimited Rights to technical data developed by the Contractor as part of this effort, and the Government may make such technical data available for future American spacecraft designers, whether those designers are employees of the government, educational institutions or private Contractors.

Program Organization, Responsibilities and Management

The NASA STORRM Team has overall program management responsibility for the entire STORRM Avionics Enclosure development activity required to design, analyze, fabricate and test all components and assemblies of the Avionics Enclosure. The NASA STORRM team is contracting selected activities or tasks such as engineering support, manufacturing and assembly fabrication tasks. This PWS specifically addresses the design, fabrication, and delivery of the MLI thermal blanket and connector covers for the STORRM avionics enclosure.

MLI Blanket Design, Analysis and Fabrication Team

Designated Contractor STORRM team members will lead and conduct the design, analysis and fabrication of the STORRM Avionics Enclosure MLI blanket. The Design, Analysis and Fabrication (DA&F) Team Lead will provide updates to the STORRM Team program manager or his designee in weekly reports and by request.

- Perform design and analyses of MLI thermal blankets in accordance with Government furnished requirements
- Design and control in accordance with Government specified guidelines and configuration control system
- Provide on-site support as needed during installation and final check-out
- Support design revisions identified during the testing, process development and manufacturing phases of the project
- For all designs, provide applicable models, drawings, and analyses

Technical Direction 1 (9/15/08): Updates the initial task order start date to September 11, 2009 as issued by the CO on 9/11/09 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. See NOC designated item(s) and description below.

In general the Contractor shall provide all site specific resources, supplies, equipment and personnel required to perform fabrication and assembly activities for the STORRM MLI blanket and components. Exceptions to this requirement are specified as Government furnished. The Contractor shall provide any fabrication as-built records or documentation to be included in the final acceptance packages for the MLI thermal blanket.

2.1: Contractor Coordination and Planning Participation

The Contractor shall perform the following requirements:

- Provide a design and fabrication lead or supervisor to act as the primary focal point for managing and coordinating the fabrication activities that occur at the fabrication sites.
- Coordinate with the in reviewing engineering build packages, tooling requirements, and raw materials to identify and recommend any changes that should be incorporated due to site specific requirements, safety, capabilities or experience.
- With advance notification, arrange site access for STORRM Team members or other NASA visitors to observe fabrication activities.
- Ensure as-built documentation complies with the configuration management requirements defined by the STORRM team.
- Participate with the STORRM team in weekly activity coordination/action item meetings
- Participate in various STORRM Team co-location activities. These co-location activities include but are not limited to PDR, CDR, work sessions, manufacturing development, coordination planning, and review of the articles being fabricated under this PWS.
- Provide manufacturing schedule and cost visibility to the STORM Team on a weekly basis during active fabrication activities and monthly otherwise.
- Collect labor actuals (hours) and material expenditures for MLI blanket hardware for use in future estimates.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required): The Contractor shall perform the above coordination and planning requirements in the time frame documented in NOCs or as master schedule changes are documented in task plan revisions or as mutually agreed upon.

2.1.3 Performance Metrics/Standards: The Contractor will warrant a “meets” rating if all requested products and services are delivered complete and on schedule. The Contractor will warrant an “exceeds” rating if all requested products are delivered ahead of schedule.

2.2: Fabrication of Avionics Enclosure MLI thermal blanket

The Contractor shall fabricate a MLI thermal blanket with the specifications listed below. Blankets shall be fabricated using materials and processes representative of those planned for space flight on the Space Shuttle and consistent with specifications listed in Section 4.

Avionics Enclosure MLI blanket Overall Specifications

- 20”x14”x14” Rectangular
- Effective emissivity of 0.03
- Electrically grounded to existing Avionics Enclosure ground lug
- Penetrations to accommodate electrical connectors
- Stitched numbering (or similar) to identify connector locations
- Velcro fasteners
- Beta cloth outer layer
- Accommodations for enclosure vent holes
- Flaps to cover lifting hardware
- Flap to cover test connectors not in use during flight

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule: The Contractor shall deliver the MLI blanket in the time frame documented in NOCs or as master schedule changes are documented in task plan revisions.

- MLI thermal blanket
- As-built fabrication acceptance package documentation for MLI blanket
- Deliver to on-site NASA STORRM team representative for integration (Boulder, CO)

Figure 2.2.1 Exploded View of STORRM Avionics Enclosure

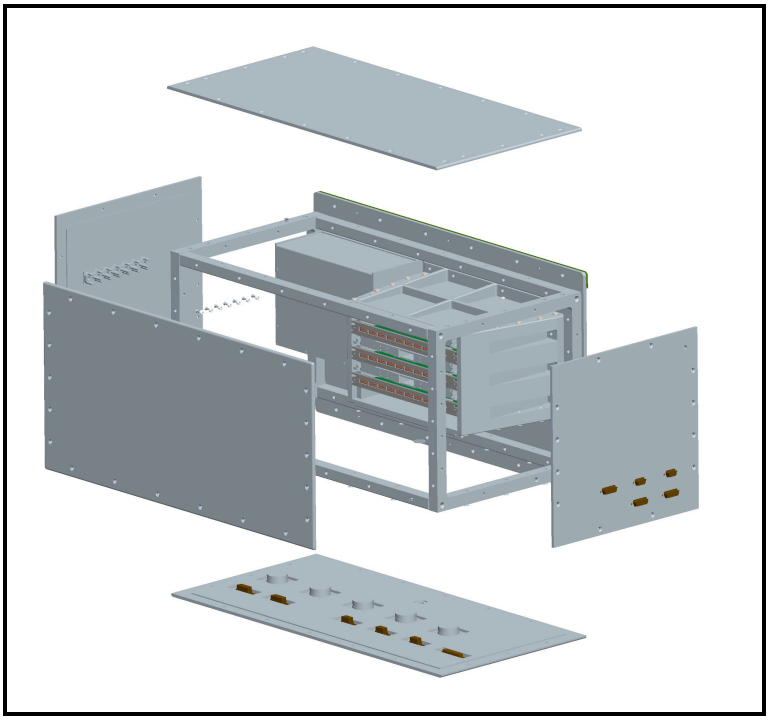
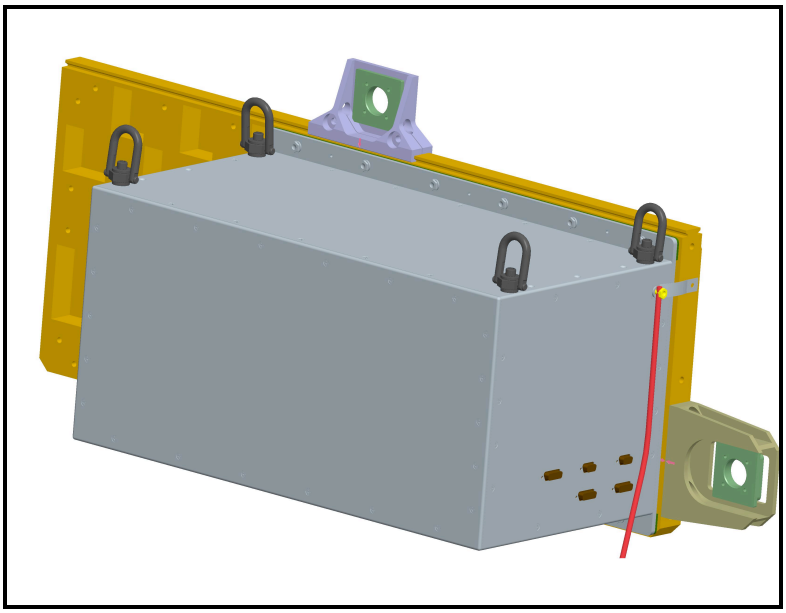


Figure 2.2.2 STORRM Avionics Enclosure mounted to APC



2.3: Fabrication of Avionics Enclosure MLI Connector Covers

The Contractor shall fabricate MLI connector covers with the specifications listed below. Connector covers shall be fabricated using materials and processes representative of those planned for space flight on the Space Shuttle and consistent with specifications listed in Section 4.

Avionics Enclosure MLI Connector Cover Specifications

- Accommodate connectors listed in Table 2.3.1
- Velcro fasteners
- Stitched numbering to identify correct connector location
- Beta cloth outer layer

2.3.1 Milestones (Optional):

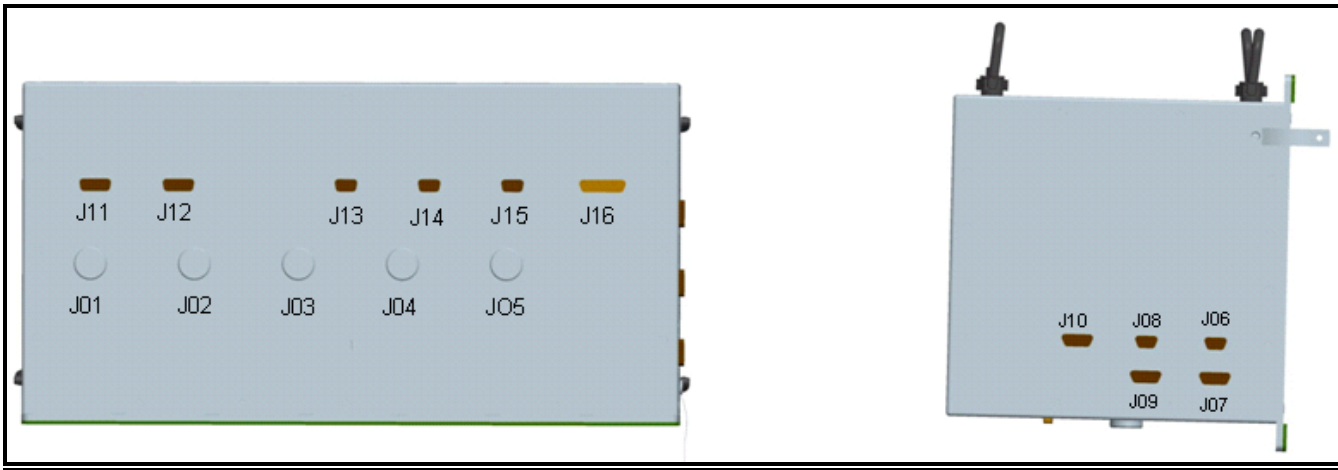
2.3.2 Deliverables and Schedule: The Contractor shall deliver the MLI connector covers in the time frame documented in NOCs or as master schedule changes are documented in task plan revisions.

- MLI connector covers
- As-built fabrication acceptance package documentation for MLI connector covers
- Deliver to on-site NASA STORRM team representative for integration

Table 2.3.1. MLI connector cover types

Connector Type	Qty
NLS0T20-35 – Wall mount Receptacles	4
ME414-0234-7246 – Wall Mount Receptacle	1
D SUB miniature Connectors	11 (TBR)

Figure 2.3.1 Avionics Enclosure Bottom and Side View with Connector Locations



2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.
Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

Major design specifications and drawings will be provided to the manufacturing/fabrication Contractor as Government Furnished Equipment (GFE) as defined in this PWS.

The NASA STORRM Team has direct responsibility to provide personnel and resources for the following tasks, activities or resources.

- Program oversight and management
- Engineering build requirements/packages (design/layout drawings, material and processing specifications, bill of materials, assembly interfaces, inspection acceptance criteria)
- Provide trained technicians to handle, clean, inspect, and closeout the MLI blanket and connector covers after integration into, and de-integration from, the Space Shuttle cargo bay.

4. Other Essential Information:

Identification, Packaging and Shipping

The Contractor shall be responsible for packaging and shipping deliverable hardware such that performance, life, and cleanliness are not degraded. The MLI blanket and connector covers shall be delivered to the STORRM Team in an enclosed shipping container protected from the elements of nature. The MLI blankets and connector covers shall be in a ready-to-use state free of contaminants that may cause degradation to the effective emissivity or solar absorption properties. Parts shall be marked with engineering numbers and as specified in manufacturing plans.

The shipping container shall be durable and legibly marked with shipping information furnished by the STORRM Team.

All deliverable hardware shall be shipped to NASA for testing per STORRM Team instructions. For estimating purposes use the address below unless stated otherwise in this PWS.

NASA/Langley Research Center
Building 1202
Hampton, VA 23681-2199

Applicable / Reference Documents

The following documents are applicable to this PWS and attached appendices to the extent specified herein. In the event of conflict between the requirements of this PWS and any referenced documents, the

requirements of this PWS shall govern.

Military Standards

N/A

Specifications

Specification No.	Description
JSC 26626A	Section 3.5, thermal blanket requirements
JPG 8080.5 M/P-12.	MLI bake-out requirements
ASTM D 6193	Standard Practice for Stitches and Seams

Documents

DTO-703-0022 DTO Safety and Mission Assurance Plan

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: [TD1] ***September 11, 2009*** Completion date: April 15, 2010

7. NASA Task Management:

Technical Monitor (Required): **Mark N. Thornblom**

M/S: 431 Phone: 757-864-8046

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 080D3-NNL09AM26T Revision: 1 Change: 0 Date: December 16, 2009

Title: HYTHIRM Imaging Campaign Asset Calibration, Enhancement, and Data Analysis

1. Purpose, Objective, or Background (Optional) Note: The requirements of this task order have previously been performed under a contract path with the Army Space and Missile Defense Command by Computer Sciences Corporation (CSC), which manages the Innovative Science and Technology Experimentation Facility (ISTEF). This previous vehicle cannot process the contract in time to support the upcoming STS-128 mission at the end of this August. Therefore NASA is seeking an alternate route that will streamline funding to ISTEF-CSC to provide engineering and consulting support to the Hypersonic Thermodynamic Infrared Measurements (HYTHIRM) project for an imaging campaign against near term NASA Space Shuttle launches and re-entry.

The goal of the HYTHIRM project is to obtain infrared (IR) imagery of select Space Shuttle missions during hypersonic re-entry utilizing existing NASA and DOD airborne assets. ISTEF CSC has supported HYTHIRM for a previous mission of the Orbiter Discovery (STS-119) in March 2009 and Atlantis (STS-125) in May 2009, and their support is needed for the remaining shuttle missions. The acquisition of such spatially resolved quantitative imagery will provide critical flight data for reducing the uncertainty associated with present day ground-to-flight extrapolation techniques, and current state-of-the-art empirical boundary-layer transition or turbulent heating prediction methods. Non-intrusive global thermography will compliment the limited discrete thermocouple data on each orbiter by providing spatially continuous surface temperatures at a targeted Mach number. Flight data is considered critical for the validation of physics-based, semi-empirical boundary-layer transition prediction methods and to stimulate the development of more accurate numerical turbulence models supporting the Constellation Program. NASA HYTHIRM will utilize various optical assets during the imaging campaign against STS-128 and subsequent missions. One of these assets is Cast Glance, a P-3 Orion based out of NAWC in Pt Mugu, Ca. Another asset is a land-based remote entry imaging system (MARS) deployed by Clay Observatory, Celestial Computing.

Technical Direction 1 (08/25/09): Updates Completion date and provides addendum for STS-128 requirements (see [TD1] Section 7, below).

Technical Direction 2 (8/26/09): Updates the initial task order start date to August 26, 2009 as issued by the CO on 8/26/09 (see [TD2] below, Section 6).

Revision 1 (12/16/09): Extends the period of performance 5 months to May 31, 2010 in continuation of NASA's support with updated requirements that allow continued data analysis for STS-128 and new support of STS-131 (addendum) (see [R1] above and below).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

[R1>]***Note: Requirements below pertaining to continued data analysis of completed missions shall be performed in coordination with NASA Technical Leads.***[<R1]

1.0 Task: HYTHIRM Program Support

The Contractor shall provide HYTHIRM program support for:

A. Participation at a pre-mission planning meeting via telecon or in person when called by the Project Manager.

B. Attendance at TIM/Workshop/Post-Mission Data Review and Analysis meetings when called by the Project Manager.

C. Participation in weekly Technical and Program Telecons.
D. Review and comment on project documents as required by the Project Manager.

2.0 Task: Sensor Characterization and Calibration

NASA HYTHIRM will utilize various optical assets during the imaging campaign against vehicle reentry and hypersonic flight observations.
The Contractor shall perform sensor characterization and calibration planning, data collection, data reduction, and analysis on applicable asset sensors for the current mission (Cast Glance, MARS, etc).

2.1 Sensor Configuration and Performance Planning

Work with asset owner to communicate configuration and sensor setup. Obtain overview and assist with sensor performance planning.

2.2 Calibration Planning

The Contractor will be provided a Mission Asset and Sensor Configuration Overview for each mission, listing the specific science sensors requiring calibration. Each asset will provide the Contractor with the detailed design and configuration of each sensor, including all optics (telescope, windows, filters, splitters) and detectors or cameras (model number, operational configuration, recording method). The Contractor shall provide a Mission Calibration Plan (Deliverable) that details the calibration of each assets' sensor for each mission. The calibration plan will provide a summary description of the methods used to determine the radiometric calibration equation, constants, and coefficients, and include a basic description of how to apply these to sensor data to yield radiance map data at the aperture or window of the sensor. The calibration plan will take into account previous calibration results derived from earlier data sets, describe the nominal per-mission limited data collection, and detail any additional data collections as required to supplement the earlier data sets. The combination of the Mission Asset and Sensor Configuration Overview together with the Mission Calibration Plan will contain the details and changes mission to mission, including asset & sensor availability, calibration data collection detail planning, and each sensor's evolving calibration data collection requirements.

The Mission Asset and Sensor Configuration Plan shall be provided to the Contractor nominally 60 days before the mission, to enable the Contractor to provide the Mission Calibration Plan 30 days before the mission. New sensors requiring characterization shall nominally be identified to the Contractor 90 days before the mission to allow additional time for coordination with new asset owners/operators, characterization & calibration operations, and calibration data analysis. The Data Analysis and Handling Plan provided to the Contractor will identify any calibration data, mission data, or sensor configuration details that require special handling, such as "Sensitive But Unclassified" (SBU), or that are subject to ITAR restrictions.

2.3 Characterization of new sensor.

The addition of a sensor that has not been previously utilized by HYTHIRM, or that has experienced major modifications, will require the Contractor to review all existing characterization and calibration data and reports, to be provided by the asset owner/operator. The Contractor will recommend, plan, and perform

additional calibration data collection to complete a full characterization and calibration of the sensor, including sufficient noise and error values to predict surface temperature accuracy and surface spatial resolution. Sufficient data will be collected to provide a broad and firm basis for calibration curves and noise statistics, to establish repeatability and reliability of calibrations mission-to-mission, and allow for reduced data collections during subsequent mission operations. The characterization data set will therefore contain more data and require more operational collection time than a routine mission data set.

To perform characterization of the new sensor(s), the Contractor shall evaluate existing asset equipment and procedures, travel to assets' location, set up sources and optics as required, provide a check list/procedure for data collection, direct data collection, verify adequate data collected before departure, receive any asset or NASA supplied calibration data, reduce data to produce calibration equations, and produce characterization report for each sensor.

2.4 Radiometric Calibration

The Contractor shall perform a radiometric calibration of mission applicable sensor(s), including use of a NIST-traceable calibrated blackbody at mission representative temperatures. Sites where this will be performed will be determined on a mission by mission basis, but will likely require travel to deployment location for aircraft assets. Additional NIST-traceable calibration sources, such as an integrating sphere or low temperature black body, may be used to provide additional data points in a short operational time span.

The Contractor shall provide results including calibration curve, calibration equation, sensor noise statistics, and surface temperature uncertainty values in the calibration report.

For each sensor supporting each mission, the reduced set of mission calibration data points shall be merged with the full characterization data set. The mission calibration data set shall include calibration sources, such as black bodies or integrating sphere, as well as mission star observations (+/- one hour of mission data acquisition time). The Contractor shall provide a list of radiometric calibration stars suitable for each sensor's spectral band and for the date and location of the observation. Additional data points may be specified as indicated by the results of the full characterization calibration.

Post-mission, the Contractor shall recommend additional calibration data collection where the mission data does not agree with the full characterization data set, such that the resulting error or uncertainty values approach the mission requirements for measured surface temperature.

The Contractor shall review sensor configuration changes between missions and make recommendations whether additional calibration data is required.

2.5 Spectral Response Calibration

The Contractor shall determine the sensor's spectral response curve within limits of existing component data, funding, and schedule. Where the spectral response curves of all optical components are available, these shall be mathematically combined to a single curve. Where the component curves are not available, the Contractor shall provide recommendation whether component or full instrument spectral bench measurements are required.

The Contractor shall also review sensor configuration changes between missions and make recommendations whether additional spectral calibration data is required. Absent configuration changes or deficiencies in characterization results, additional routine mission spectral data collection is not expected.

2.6 Spatial Resolution Calibration

The Contractor shall measure sensor system spatial resolution as part of the characterization process, and produce a representative Point Spread Function (PSF). Sources may include collimated pinholes, low power laser, and star observation. The Contractor shall optionally provide Point Diffraction Interferometry or similar capability to allow precise in-situ measurement of a sensor's optics system overall performance, including: aberrations, Modulation Transfer Function (MTF), Point Spread Function (PSF), Strehl Ratio, and Zernike coefficients.

The performance of the mount/gimbal while tracking shall be measured to provide pointing, jitter, and vibration statistics that impact spatial resolution. The typical method is to track and record a satellite pass in "terminator" conditions, where the satellite is solar illuminated but the sensor experiences local darkness. The Contractor shall assist in planning the data collection, and provide a schedule of candidate satellite passes with ephemeris data. The Contractor shall provide conversion of ephemeris, date, time, and location data to a trajectory file if required by the asset. The Contractor shall analyze the recorded image data and mount/gimbal pointing/encoder data to determine jitter and vibration statistics within the limits of the data.

Star observations near mission time (+/- one hour) shall provide additional functional spatial resolution data representative of mission performance, including atmospheric conditions and mount/gimbal performance. The Contractor shall analyze for spatial resolution the same mission star data set collected for radiometric calibration purposes.

2.7 Procedures

The Contractor shall provide technical assistance to asset owners/operators in their development of procedures to implement the above characterization and mission calibration tasks.

The asset owner/operators shall implement a method of configuration control of characterized and calibrated sensors, to allow prior notification of sensor changes that may affect the calibration, and resulting additional calibration data collection post modification.

2.8 Mission Planning and Support – Calibration & Sensor Performance

2.8.1 Pre-Mission Calibration Updates

The Contractor shall provide pre-mission updates to radiometric calibrations as new data is available without waiting for delivery in the full calibration report, to assist in radiance modeling and sensor operations planning. (Deliverable)

2.8.2 Pre-Mission Sensor Performance

The Contractor shall provide advice and assistance to other team members during mission planning to aid in interpretation of calibration results and limits of sensor performance relative to mission goals and requirements. The Contractor shall recommend sensor configuration details, such as integration time and gain settings, with expected SNR curves and limits of measurable temperature range.

2.9 Mission Calibration Update – Thermocouple Data Reconciliation

The Contractor shall receive vehicle thermocouple data and a 3D Surface Temperature data file for each HYTHIRM sensor (described under Mission Data Reduction and Analysis) from NASA and reconcile the two data sets. In the case where the two temperature data sets consistently disagree by more than a tolerance limit based on a combination of their calibration noise/uncertainty values, the Contractor shall use the TC data to adjust the remote sensor's radiometric calibration to bring the data sets closer to agreement. The Contractor shall make a single adjustment per sensor. The Contractor will be provided guidance by the PI

and PM on the mission time span to include in the reconciliation, and the mission specific tolerance limit. Should adjustment be required, the process and resulting calibration equations shall be described in the sensor's Mission Calibration Report.

2.10 Mission Calibration Report

The Contractor shall provide a Mission Calibration Report (Deliverable) for each sensor to include calibration curves & equations, noise statistics, typical surface temperature accuracy, spatial resolution, and spectral response curves. The report shall include the results of data reduction and analysis of the full sensor characterization, and shall merge the results of subsequent mission calibration data sets. The full Mission Calibration Report shall be completed independent of whether mission data has been successfully captured. The report shall be delivered to NASA LaRC within 6 weeks from completion of calibration data collect or receipt of the data at ISTEF.

3.0 Task: Mission Support Quick Look Analysis

This task will involve reviewing raw mission data and providing the quick look images and movie files. The sensors requiring Quick Look Analysis for each mission will be identified in the Data Analysis and Handling Plan, which will nominally be provided to the Contractor 60 days before the mission.

3.1 Quick Look Data Review

The Contractor shall review the raw mission data for overall quality, qualitative sensor performance, and mission events observable in the data. Planned or predicted events or features, such as BLT DTO signatures or similar, shall be examined as a priority. Unplanned or un-expected events or features shall be noted, and those related to aero-thermal effects shall be selected to include in quick look images and video clips. Initial qualitative comparison of events to selected vehicle data (such as thermocouple temperatures) shall be made as the vehicle data is available, expected to take a few weeks calendar time, and be performed in coordination with other team members and with target post mission telemetry

3.2 Quick Look Analysis of Mission Data

The Contractor shall process selected raw data frames or short sequences identified from the data review, apply the Quick Look Calibration values to yield preliminary global thermal map example frames or video clip. The Contractor shall supply the movie files in two forms, the raw (grayscale) data and the data converted to color coded surface temperature via the preliminary radiometric calibration.

The quick look analysis of sensor mission data shall first produce selected single frames in gray scale within one day of receipt. Quick look analysis shall then produce movie clip files in gray scale created using object tracking and sub frame window extraction, resulting in a motion stabilized version of the raw data. The preliminary calibration shall be used to convert motion stabilized raw data to surface temperature image sequence. The Contractor shall deliver the "Quick Look Grayscale Movie" and "Quick Look Global Surface Temperature Movie" within 5 business days of mission completion or receipt of the data at ISTEF (Deliverable). The Contractor shall use a single nominal set of atmospheric transmission and path radiance/solar scattering values to correct for these radiometric effects. The intent is to demonstrate the date was successfully collected, and provide an initial visualization of the data quality.

4.0 Task: Mission Data Reduction and Analysis

4.1 Atmospheric Path Parameters

The Contractor shall determine atmospheric path transmission and radiance/solar scattering values for the changing path between the hypersonic vehicle and the observing sensor, including geometry changes over time due to vehicle and sensor platform motion.

4.2 2D to 3D Data Geometrical Transformation with Conversion to Surface Temperature

The Contractor shall apply 2D sensor image data to the 3D vehicle model through geometric transformation and registration. The Contractor shall utilize the following NASA supplied data, each with error/noise estimates:

- 3D model(s) of the vehicle surface with material ID
- Vehicle planned or post-mission trajectory (position) data and attitude data
- Vehicle surface material properties including:
  - Bi-directional Reflectance Distribution Function (BRDF)
  - Bi-directional Emittance Distribution Function (BEDF)
- Sensor platform location or flight path/position data
- Sensor platform gimbal or tracking mount pointing angles
- Sensor raw data and calibrations (if not performed by the Contractor under other tasks)

The Contractor shall utilize the sensor calibration data, the atmospheric path parameters, and the local vehicle material ID with BRDR & BEDF, to convert sensor counts to surface temperature, and record these values in a 3D file format with time index, referred to as "3D Surface Temperature File". (Deliverable)

The Contractor shall perform a rotation transformation to render the 3D surface temperature to a standard view angle, such as normal to the center of the bottom of the vehicle. This version of the data shall be rendered in a "Normal View Global Surface Temperature Movie" in a common video file format, with color coding indicating temperature. (Deliverable)

4.3 Comparison of Thermocouple and HYTHIRM Surface Temperature Data

4.3.1 The Contractor will be provided vehicle thermocouple (TC) locations, TC calibrations, and TC mission data by NASA. The Contractor shall add the TC mission data as a time synchronized layer in the 3D Surface Temperature data file.

4.3.2 The Contractor shall perform a basic comparison of the two surface temperature data sets now contained within the 3D Surface Temperature data file, using instantaneous, nearest time value (no time averaging) and single pixel (no spatial area or time averaging) methods. This basic comparison shall be visualized using indicated temperature and temperature difference plots versus mission time. The indicated temperature plots shall include running mean and calibration derived three sigma noise/uncertainty bands for both the thermocouple and remotely sensed temperatures values. (Deliverable)

4.3.3 The Contractor shall perform a time averaged comparison of the two surface temperature data sets, using a time span selected by the Contractor based on inspection of the data. Both the thermocouple and the remotely sensed temperature values shall be averaged over the same time interval. The comparison results

shall be visualized using the same methods and plots as described above for the basic comparison.(Deliverable)

4.3.4 The time averaged comparison shall be additionally visualized using the "Normal View Surface Temperature Comparison Movie", where both time averaged data sets are represented. Differences in TC versus remotely sensed temperatures shall be apparent as color differences at the TC locations. (Deliverable)

4.4 Sensor Coverage and Quality Visualization

The Contractor shall provide the following graphical visualizations rendered over mission time.

4.4.1 Sensor Spatial Coverage Visualization

The Contractor shall use the input data and transformation methods listed above to illustrate sensor coverage on the normal view of the vehicle.

The basic coverage shall be indicated by a "pixel grid" representation of the sensor pixels as transformed on to the 3D vehicle surface, changing as a function of mission time and relative motion. The pixel grid shall provide a basic visualization of the wrapping of sensor data around the complex 3D shape of the vehicle. This visualization shall be performed for each frame of the sensor data, and delivered both as a time synchronized layer in the 3D surface temperature data file, and rendered as a separate common video format file (Deliverable). In addition to basic coverage, this visualization will be an aid to users of the surface temperature data to visually examine the effect of individual pixels as they interact with specific surface features over time, relative motion, and transformation, all examined from the "normal view".

4.4.2 Surface Temperature Spatial Resolution Visualization

The spatial resolution shall be represented by a "PSF Spot Array", illustrating the point spread function of the sensor as it is distorted by the geometrical transformation to the local surface. The amount and type of distortion will change significantly over time and across the surface of the vehicle, due to the changing surface curvature and relative motion of the vehicle and sensor platform. This method of visualization shall best represent the interaction of the 3D surface with the 3D PSF, as opposed to a rectilinear line "PSF grid" which would over simplify the resulting complex gradient. The PSF Spot Array shall be delivered as a time synchronized layer in the 3D surface temperature data file, and as a movie in a separate common video file (Deliverable).

4.4.3 Sensor Data Quality Visualization

The Contractor shall use the input data and transformation methods listed above to illustrate sensor quality on the normal view of the vehicle. The quality shall be indicated by a gray scale or color coding representing the local value of one of the following indicators of the sensor data quality:

- signal to noise ratio
- three sigma combined noise/uncertainty, in surface temperature units
- ratio of thermal emission energy to combined energy due to solar reflectance and path radiance/solar scattering

Each quality visualization shall be delivered both as a time synchronized layer in the 3D surface temperature file, and as separate movies in a common video file format (Deliverables).

5.0 Task: Mission Data Enhancement Using Advanced Deconvolution

The Contractor shall apply advanced deconvolution algorithms to selected time spans of mission raw sensor data, to ameliorate atmospheric turbulence and motion/vibration blur effects. The resulting data shall preserve radiometric calibration. The resulting data shall be delivered as 2D image sequence file

(Deliverable) to be available for further processing, such as 2D to 3D transformation.

The Contractor shall generate numerical and graphical representations of resulting spatial resolution improvement, and shall generate a brief report describing the results. (Deliverable)

6.0 Task: Academic Papers

The Contractor shall co-author academic papers at the direction of the PI and PM, for publishing by NASA, to describe the results of HYTHIRM and the Contractor's contributions.

7.0 Task: Asset Enhancements

7.1 Asset Sensor System Improvements

The Contractor shall evaluate and modify an asset sensor including its control and recording system to improve performance towards goals of increased performance and reliability. Both hardware and software modifications shall be evaluated and a solution recommended. The system shall be tested for reliability after modifications are complete. Additional operator procedures shall be provided to maintain system performance mission-to-mission.

8.0 Deliverables and Schedule

Statement of Work	Deliverable	Due Date	Deliver to
2.2	Mission Calibration Plan	L-30 days	NASA LaRC and Sensor Agency
2.8.1	Pre-Mission Calibration Updates	L-10 days	NASA LaRC and Sensor Agency
2.10	Mission Calibration Report	6 weeks from completion of calibration data collect or receipt of the data at ISTEF	NASA LaRC and Sensor Agency
3.2	Selected single frames in gray scale	1 business day after receipt of the data (likely on-site)	NASA LaRC and Sensor Agency
3.2	"Quick Look Grayscale Movie" and "Quick Look Global Surface Temperature Movie"	5 business days after receipt of the mission data at ISTEF	NASA LaRC and Sensor Agency
4.2	3D Surface Temperature File	2 months after receipt of the listed required data at ISTEF	NASA LaRC
4.2	Normal View Global Surface Temperature Movie	2 months after receipt of the required data at ISTEF	NASA LaRC
4.3.2	Basic Comparison of TC and Global Surface Temperature data	2 months after receipt of the required data at ISTEF	NASA LaRC
4.3.3	Time Averaged Comparison of TC and Global Surface Temperature data	2 months after receipt of the required data at ISTEF	NASA LaRC
4.3.4	Normal View Surface Temperature Comparison Movie	2 months after receipt of the required data at ISTEF	NASA LaRC

4.4.1	Sensor Spatial Coverage Visualization	2 months after receipt of the required data at ISTEF	NASA LaRC
4.4.2	Surface Temperature Spatial Resolution Visualization	2 months after receipt of the required data at ISTEF	NASA LaRC
4.4.3	Sensor Data Quality Visualization	2 months after receipt of the required data at ISTEF	NASA LaRC
5.0	Mission Data Advanced Deconvolution image sequence file and report	2 months after receipt of the required data at ISTEF	NASA LaRC

9.0 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Meets: Timely (as specified) and complete deliverables.

Exceeds: Meets and a) 12 of 14 deliverables completed 30% earlier than specified or b) 7 of 14 deliverables completed 50% earlier than specified.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

4. Other Essential Information:

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

6. Period of Performance:

Planned start date: [TD2]August 26, 2009 Completion date: [TD1]~~Dec 31, 2009~~ ***May 31, 2010***

7. NASA Task Management:

Technical Monitor (Required): **Deborah M. Tomek**
M/S: 170 Phone: 757-864-7302 (Cell: 757-969-8653)
Other POC (Optional):
M/S: Phone:

Begin [TD1] Addendum
[R1>]***Note: For planning purposes, coverage for STS-131 is the same as for STS-128***[<R1]

Addendum for STS-131

This task order identifies the specific tasks from the HYTHIRM ISTEF-CSC Statement of Work (SOW) that will be performed for a specific mission or period of time. SOW paragraph numbers will are listed together with asset sensors and/or data sets in table format. "Y" indicates the task will be performed for the task order. Notes will be included where required to clarify a limitation or restriction of SOW task unique to the mission or time period. This Task Order cannot be used to add tasks to the SOW. The assets addressed in this task order include Cast Glance (CG) and Clay Observatory (Clay MARS). Sensors include Near Infrared (NIR) and Mid-Wave Infrared (MWIR).

Mission: STS-131

SOW Para.	HYTHIRM Program Support	CG NIR Sensor	CG MWIR Sensor	Clay MARS SWIR Sensor	Clay MARS NIR Sensor
1.1	Y				
1.2	N				
1.3	Y				
1.4	Y				
2.1	-	-	-	-	-
2.2	Y (1)	Y	Y (2)	-	-
2.3	-	-	-	-	-
2.4	Y	Y (11)	Y (2)	-	-
2.5	-	Y (3,11)	-	-	-
2.6	-	Y (4,11)	-	-	-
2.7	Y	Y	-	-	-
2.8.1	Y	Y	-	-	-
2.8.2	Y	Y	-	-	-
2.9	N	N (5,11)	-	-	-
2.10	N	N (6,11)	-	-	-
3.1	Y	Y	-	-	-
3.2	Y	Y	-	-	-
4.1	-	-	-	-	-
4.2	-	-	-	-	-

4.3	-	-	-	-	-
4.4.1	- (7)	-	-	-	-
4.4.2	- (7)	-	-	-	-
4.4.3	- (7)	-	-	-	-
5.0	N (8)	N	-	-	-
6.0	N (9)	N	-	-	-
7.1	-	Y (10)	-	-	-

Notes and Limitations

(1) The Mission Calibration Plan nominal deliverable due date of L-30 days does not apply as it is earlier than ATP for STS-131.

(2) CG MWIR Radiometric Calibration support for STS-131 is limited to collection of calibration data only. Calibration data reduction for this sensor is not required in this TO.

(3) CG NIR Spectral Response Calibration will include reduction of prior spectral filter data collected at Pt. Mugu. High resolution spectral throughput calibration data collection is included, but is contingent on arrangements for equipment, including VIS-NIR spectrometer and light source.

(4) CG NIR Spatial Resolution Calibration will not include reduction of prior PSF data, including collimated pin hole and flight star data. High resolution optical interferometric data collection is included but contingent on arrangements for equipment, including permissions for use of low power laser at the Cast Glance deployment location.

(5) Thermocouple data reconciliation for CG NIR calibration is included for STS-119, STS-125, and STS-131 data sets, if required. This task is dependant on receipt of thermocouple (TC) data, TC calibrations, and TC uncertainty statistics from NASA or other contractors. The product is limited to updated radiometric calibration equations and constants. This task will not produce radiance map images or temperature images from mission data.

(6) The calibration report for CG NIR will include results of merging calibration data sets from STS-119, STS-125, and STS-131.

(7) Sensor Coverage and Quality Visualization tasks require the geometry and image processing solutions from the 2D-3D Geometrical Transformation task as prerequisite.

(8) Mission Data Enhancement Using Advanced Deconvolution is limited to a demonstration of capability using two short data sequences yielding one enhanced image each, as an indication of results for future full sequence processing. The short sequences will be selected from the CG NIR STS-119 and STS-125 data sets. This demonstration will use algorithms and code on hand with limited tuning for data sets. This demonstration may include use of a subcontractor for demonstration of one algorithm, pending approval of the Program Manager, as supplement to the algorithms demonstrated by the contractor.

(9) The contractor will support three papers as contributing author. NASA will release and present the resulting papers, thus the contractor will not be responsible for ITAR review before release.

(10) The CG NIR control and recording system will be further enhanced to reduce latency and improve reliability, with the goals of eliminating dropped frames and decreasing time tag jitter. Enhancements to be evaluated include operating system major update; solid state drive upgrade (including specification, installation, configuration, and test); installation of real time kernel; real time tuning of recording tasks; reliability testing; updates and improvements of procedures; and modification of existing system case. Time tag accuracy requirement remains at +/- 0.5 seconds. The proposed

modification "camera integration sync to time code latch" to eliminate varying delays in assigning time tags to frames and achieve 1 millisecond accuracy is not required for STS-131.

(11) Post-mission calibration data reduction & analysis, reconciliation of multiple mission data sets, TC data reconciliation, final calibration report, advanced deconvolution, and academic papers have been deferred awaiting future funding.

End [TD1] Addendum

TASK ORDER NUMBER: 081D3-NNL09AM29T Revision: 0 Change: 0 Date: September 18, 2009

Title: **Accuracy and Speed Improvements to USM3D**

1. Purpose, Objective, or Background (Optional): (New work previously performed on another contract)

- *Provide accuracy and speed improvements to USM3D* – NASA Langley is relying heavily on the USM3D flow solver to support several projects under the NASA Constellation Program and Aeronautics Program. There is a continuing need to increase the speed and reduce the memory for the flow solver, as well as develop advanced turbulence model capability, especially for massively separated flows and jet flows.

Technical Direction 1 (9/25/09): Updates the initial task order start date to September 25, 2009 as issued by the CO on 9/25/09 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. See NOC designated item(s) and description below.

2.1 Accuracy and speed improvements for USM3D

a) *USM3D code efficiency improvements.* USM3D supports several projects within the NASA Constellation Program and Aeronautics Program. Each of the sponsoring projects requires hundreds of flow solutions to populate aerodynamic databases, or solutions from very long time-accurate computations with advanced turbulence models to accurately compute massively separated flows. The CONTRACTOR SHALL identify and implement promising programming strategies and numerical techniques, such mixing elements and cache efficiencies to reduce the overall solution run time.

b) *Implementation of advanced turbulence models for near- and post-stall flight conditions.* There is a cross-project need for improved physics models within USM3D to reduce uncertainty of numerical predictions of stability and control characteristics for aircraft encountering massively separated flows during damaged or flight upset conditions. The CONTRACTOR SHALL implement and validate advanced turbulence models into USM3D, such as the *k-w* model, the Delayed Detached Eddy Simulation (DDES) model, and models that are under development through a collaborative NRA-funded task with Prof. S. Girimaji of the University of Texas.

2.1.1 Deliverables and Schedule:

At the conclusion of this task assignment, the CONTRACTOR SHALL deliver to LaRC the items as follows:

a. Modifications to USM3D code leading to at least 30-percent faster performance relative to CVS12192007 version.
b. Implementation and validation of advanced turbulence models into USM3D version CVS12192007.
c. CVS controlled source code of modified USM3D code containing upgraded capabilities.
d. Records of USM3D code modifications and testing results sufficient to meet ISO 9000 requirements for low-control software.

2.1.2 Performance Metrics/Standard:
Minimum acceptable performance (MAP)/Schedule:

Provide a stable version of improved USM3D to the Technical Monitor by 12/31/10.

Exceeds performance: Completion of tasks 2 weeks prior to MAP completion date.

2.n Working Environment Safety and Organization.
The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to the [R2]support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The Government will 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. Other Essential Information:

USM3D expertise for Subtask 2.3 currently resides in Analytical Services & Materials, Hampton, VA

5. Security Clearance:

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. Period of Performance:

Planned start date: [TD1]***September 25, 2009*** Completion date: December 31, 2010

7. NASA Task Management:

Technical Monitor: Neal T. Frink
M/S: 499 Phone: 757-864-2864

TASK ORDER NUMBER: 004E1-NNL09AM30T Revision: 0 Change: 0 Date: September 23, 2009

Title: Technical & Business Management Support for Aero New Business Strategy Development

1. Purpose, Objective, or Background (Optional)

The ARD New Business Team is developing strategies to attract new business opportunities that seek to leverage existing skill sets and facilities at NASA Langley Research Center. The New Business Team Lead is engaged in critical discussions with a broad range of industry and government personnel. The new business opportunities require the cooperation and support of NASA Langley Management, including Directors and Branch Managers. The New Business Team Lead is charged with developing an overall strategy for aeronautics new business opportunities at the Center. TD1> Contractor support is required to mentor, coach, and train NASA in processes, tools and techniques in how to develop strategies. The Contractor will not be required to help develop the new business strategies.<TD1

Technical Direction 1 (9/25/09): Clarifies Contractor's support role (see TD1 above).
Technical Direction 2 (9/30/09): Updates the initial task order start date to September 30, 2009 as issued by the CO on 9/30/09 (see TD2 below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 (Requirement/subtask number one):

a) The Contractor shall mentor the New Business Team Lead on best practices, approaches, and tools for developing new business opportunities.
b) The Contractor shall provide coaching support for the New Business Team Lead in organizational and communication skills related to new business relationship development strategies.
c) The Contractor shall advise the New Business Team Lead on proven long-term planning skills and partnership and collaboration development.
d) The Contractor shall provide process improvement recommendations to the NASA Technical Monitor.

2.1.1 Milestones (Optional):

Create a coaching plan to include a list of recommended readings and scheduled mentoring sessions by Nov. 15, 2009.

Conduct first Coaching session by Dec. 1, 2009

2.1.2 Deliverables and Schedule (Required):

a) A schedule of coaching goals and sequence of learning (a syllabus). – Dec. 1, 2009

b) A report of observations and demonstrated progress on techniques and approaches for collaboration and partnership development techniques – Monthly

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

(a) Reports summarizing project status and resolved issues quarterly or as requested; and
(b) Quarterly meetings with the task monitor or other designated NASA manager to discuss proposed improvements and progress on coaching and mentorship.

Exceeding minimum acceptable level:

(a) Reports summarizing project status and resolved issues to the NASA Technical Monitor by

the 10th of each month; and

(b) Monthly meetings with the task monitor or other designated NASA manager to discuss proposed improvements and progress on coaching and mentorship.

2.n Sub-Task - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Minimum acceptable level:

There are no repeated findings or incidents in six-month award fee period.

Exceeding minimum acceptable level:

There are no cited findings or reportable incidents in six-month award fee period.

3. Government Furnished Items: N/A

4. Other Essential Information: N/A

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): ITAR and Company proprietary information. OCI avoidance plan is required for this Task Order.

6. Period of Performance:

Planned start date: TD2 ***September 30, 2009*** Completion date: May 31, 2010

7. NASA Task Management:

Technical Monitor (Required): Vincent Schultz

M/S: 264 Phone: 757.864.5184

Other POC (Optional):

M/S: Phone:

Sections 1 through 3.

1. Task Summary:

This task supports the NASA Recovery Act work sponsored by the Aeronautics Research Mission Directorate and the Airspace Systems Program. Research funded by this task will focus on addressing the capacity challenges facing the US national airspace. It is forecast that over the next 15 years, air traffic in the United States will double, far exceeding the country's current capability to safely fly aircraft. To handle this growth, NASA is contributing toward the development of the Next Generation Air Transportation Management System (NextGen).

In support of these efforts, the contractor shall develop a 15-year UAS Research and Development (R&D) roadmap that addresses key enabling technologies and the resources and facilities needed for implementation. In addition, the contractor shall conduct an initial sense and avoid simulation study designed to identify requirements for UAS autonomous collision avoidance for all classes of unmanned aircraft.

Task Milestones

These milestone(s) mark significant components of successful task completion. See section 3.0 for further details on deliverables associated with this task.

Ref	Milestone Description	Due Date	Completion Criteria
A	"UAS Classification System" as framework for R&D roadmap delivered	02/2010	Classification systems addresses all UAVs from very large to very small. See Deliverable 3.1.3.
B	Final "R&D Roadmap" presented	09/2010	Presentation and final report. See Section 3.1 and Deliverable 3.1.8.
C	Sense & avoid requirements simulation study presented	9/2010	Presentation and final report. See Section 3.2 and Deliverable 3.2.2

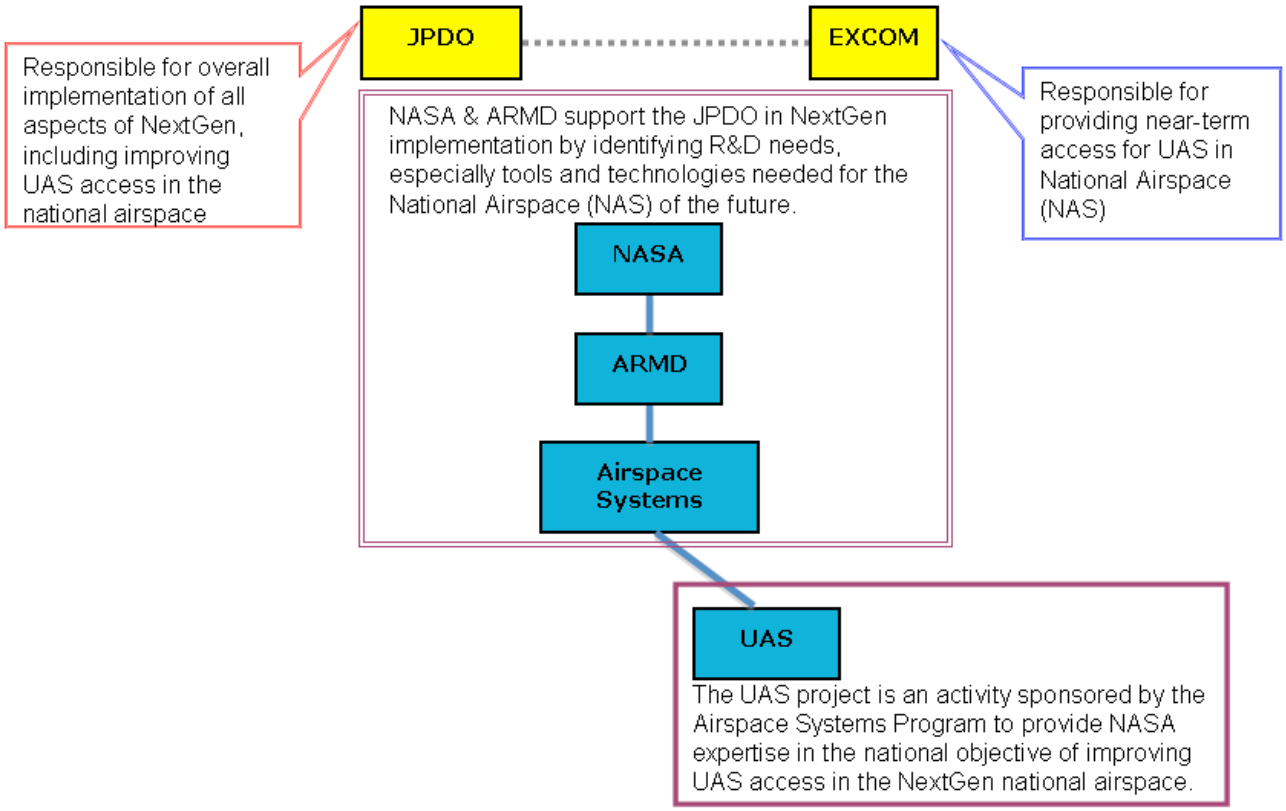
2.0 Task Background

The following sections provide some summary information about the UAS Project and the Recovery Act work that will be performed within the project.

2.1 UAS Project Stakeholders

Unmanned aircraft systems (UAS) represent new vehicle and operational concepts in civil aviation. These new concepts are evolving as the nation moves toward the Next Generation Air Transportation System[1] (NextGen), which is under the leadership of the Joint Planning and Development Office (JPDO). The desire

and ability to fly UAS in the National Air Space (NAS) in the near term has increased dramatically. In response to this, the FAA and DOD formed an executive committee for UAS NAS access (UAS EXCOM) with invitation for NASA to participate. The UAS EXCOM is comprised of senior executives from the FAA, DOD, NASA, and DHS. It is anticipated that the UAS EXCOM will provide the strategic vision for both long term and nearer term UAS NAS access activities. ARMD and the Airspace Systems Program provide NASA support of NextGen Unmanned Air implementation activities to both the JPDO and EXCOM via the UAS Project. A simple diagram of this is included here:



Although unmanned aircraft have the ability to support a number of "dull, dirty and dangerous" missions required by the nation's science community (NASA, NOAA), emergency management (FEMA, DOA) and national security and defense organizations (DHS, DOD), existing federal air regulations, procedures and technologies do not allow routine UAS access to the NAS. The current process of requesting a Certificate of Waiver of Authorization (COA) to operate a UAS in the national airspace today is extremely resource intensive and lengthy. These COAs are restrictive and often lack the flexibility to meet the full mission needs. The UAS project provides NASA support to this multi-agency objective of enabling safe, routine access for unmanned aircraft systems in the national airspace.

2.2 UAS Project Major Activities

Over the course of the next 12 months, the UAS Project will focus on supporting a multi-agency effort to develop and implement a national plan to successful address the challenges of UAS access to the NAS (National Air Space) in a safe and timely manner. In order to support this activity, the UAS Project will develop two Concept of Operations (ConOps) documents. From these documents, overall Research and Development (R&D) needs will be identified and a research plan will be written.

Both Concept of Operations (ConOps) will document principles, assumptions and constraints; describe current and future-state UAS functions and operational capabilities; and describe UAS operational performance characteristics, thereby creating a baseline of UAS mission needs, operations, systems, and capabilities.

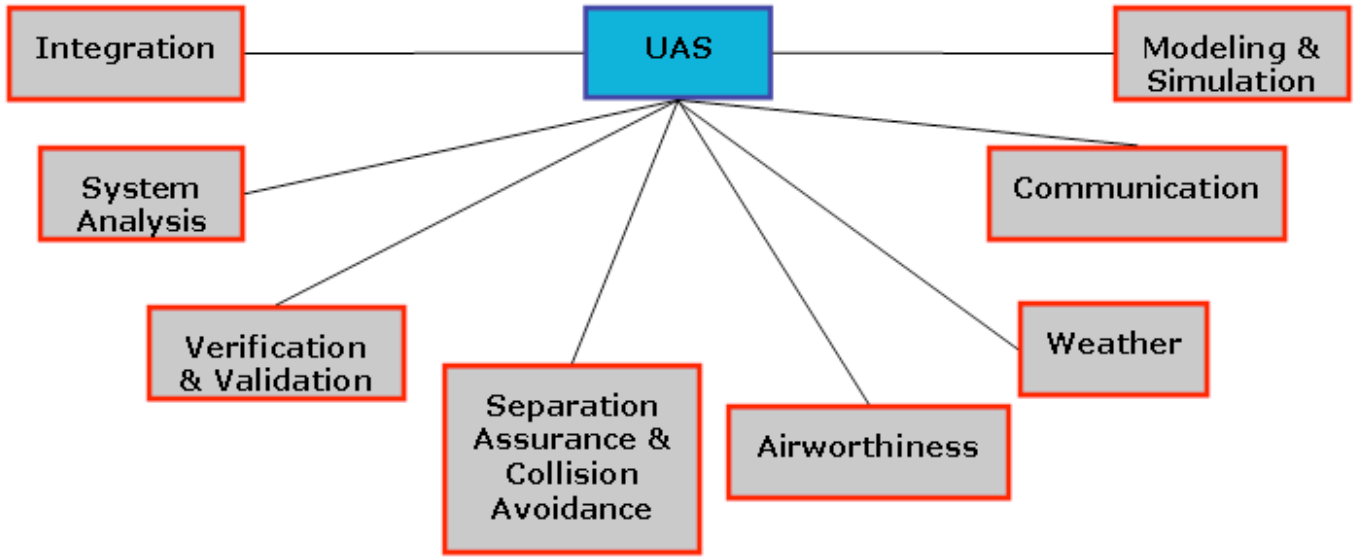
2.2.1 NASA will develop a Consolidated Concept of Operations (ConOps) by merging existing UAS ConOps from several government agencies. A state of the art assessment will be conducted that identifies and documents how UAS access the national airspace today. It will also identify and document any work that is ongoing relevant to enabling operations as defined in the Consolidated ConOps. Subsequent to this, a gap analysis will be conduced based on the state of the art assessment and the Consolidated ConOps to identify research and technical areas requiring maturity in order to achieve the operations envisioned in the Consolidated ConOps.

2.2.2 The second Concept of Operations that the UAS Project will support is the NextGen ConOps. This ConOps will be comprehensive in scope by addressing the long term civil UAS requirements that align with the NextGen framework. This document will be the baseline document used by NASA to support larger multi-agency planning efforts with external stakeholders such as EXCOM or the JPDO.

Based on its technical expertise, NASA will strongly contribute to the identification of overall Research & Development (R&D) needs and provide the critical data and understanding necessary to successfully support the multiagency planning effort via both of these efforts.

2.3 UAS Project Structure

The UAS Project will draw on NASA expertise at all four Aeronautics Research Centers. The chart below presents a summary view of the project and its main work elements.



Integration:
These activities include system engineering, project and mission management, requirements management and partnership development (eg, JPDO and EXCOM). These activities will be performed in a separate Recovery Act task outside this contract.

System Analysis:
These activities include technology evaluations, system and trade studies and identification of operational issues affecting safe UAS operations.

Verification & Validation:
Verification and Validation activities will focus on verification of hardware and software.

Separation Assurance & Collision Avoidance
This work will focus on requirements development necessary to ensure safe separation be maintained by the UAS from other air traffic, natural and manmade obstacles.

Airworthiness:
These activities will focus on mission planning, crew requirements, human factors, maintenance and other areas required in order to achieve an airworthy operation. These activities will be performed in a separate Recovery Act task outside this contract.

Weather:

These activities will focus on weather forecasting and specific UAS issues relating to icing. These activities will be performed in a separate Recovery Act task outside this contract.

Communication:
These activities will focus on communication links (satellite, line of sight, network, and data link protocols) and studies to determine whether proposed NextGen communication schemes can accommodate UAS. These activities will be performed in a separate Recovery Act task outside this contract.

Modeling & Simulation:
These activities will focus on research issues that can be studied or better understood by modeling or simulating; for example evaluating existing or future concepts associated with airspace operations or contingency management.

[1] More information about the Next Generation Air Transportation System (or NextGen) and the JPDO can be found at http://www.jpdo.gov/nextgen.asp

3.0 Task Descriptions
This task supports "Systems Analysis" and "Separation Assurance & Collision Avoidance" activities.

3.1 UAS R&D Roadmap The contractor shall develop a 15-year UAS R&D Roadmap that addresses key enabling technologies and the resources and facilities needed for implementation. As a first-step, the contractor shall develop multiple scenarios, which describe how a UAS might operate in the future, for both public-use and civil UAS access to the NextGen. The scenarios shall address three specific transitional timeframes; 2015, 2020, and 2025. Each 5-year period will introduce new technologies that enable additional capabilities leading to a fully integrated solution by 2025. Together, these three steps in time represent a 15-year roadmap for technology development and maturation.

Utilizing the scenarios developed and the contractor's expertise in verification and validation, and separation assurance and collision avoidance, the contractor shall fully support the NASA Dryden contractor in the development of functional requirements, a state-of-the-art assessment of each technology, and a gap analysis. The contractor shall work in cooperation with the other subject matter experts at NASA Dryden, Ames, and Glenn Research Centers in developing these analyses along with the consolidated and NextGen CONOPS.

Utilizing the consolidated gap analysis and the state-of-the-art assessment developed by NASA Dryden and recognizing that the technology gaps may be dependent upon the overall size (volume, weight, span, etc.) of the UAS, the contractor shall develop a UAS classification system or utilize an existing system to then further refine the technology gaps for each class of UAS and establish the current state-of-the-art (how things are done in the research environment) in each. The contractor shall develop a complete bibliography of research supporting the state-of-the-practice and state-of-the-art assessments for each class of UAS.

With the technology gaps identified for each class of UAS, the contractor shall develop a R&D roadmap for

the 2010 thru 2025 timeframe that closes each technology gap to a technology readiness level (TRL) of at least 6 or higher for each class of UAS. The contractor shall identify fundamental studies needed to elucidate requirements where none exist and technology development where the requirements are clear but the state-of-the-art has not yet achieved TRL 6. The contractor shall develop resource estimates to include total dollars, workforce, and facilities needed to complete the R&D roadmap. The final R&D Roadmap shall provide input to other documents.

The following deliverables shall support this task.

Ref	Deliverable Description	Due Date	Completion Criteria
1	"R&D Roadmap" Work Plan	3 weeks after task award	Schedule and metrics for Deliverables 2-8 are complete.
2	"Future UAS Scenarios" for public-use (govt) and civil UAS access to guide R&D Roadmap	01/2010	Scenarios address all UAVs with no size or weight limitations. See below.
3	"UAS Classification System" as framework for R&D Roadmap	02/2010	Classification systems addresses all UAVs from very large to very small
4	State of the Art (SOA) Assessment and Gap Analysis	4/2010	Existing practices and gap analysis of separation assurance / collision avoidance issues are identified for all classes of UAS
5	Draft "R&D Roadmap" completed	06/2010	Level I milestones identified with initial resource estimates
6	First revised "R&D Roadmap" completed	07/2010	Level I and II milestones identified along with revised resource estimates
7	Second revised "R&D Roadmap" completed	08/2010	Level I, II, and III milestones identified along with revised resource estimates and facility needs identified
8	Final "R&D Roadmap" completed	09/2010	See technical acceptance section below.
9	Monthly progress report	Monthly	See technical acceptance measurements below

Technical Acceptance Measurements

The government shall have two weeks to evaluate all deliverable submissions and shall use the following to determine technical acceptance of deliverables.

Work Plan

- "R&D Roadmap" work plan (Deliverable 3.1.1). The contractor shall prepare and present a work plan/task plan which outlines their proposed schedule and metrics for satisfying each of the deliverables listed below. This plan shall be presented to the government for approval within three weeks of contract award or in accordance with the task order clause of the contract. Any change to the work plan/task plan shall be mutually agreed to by the government and the contractor.

Future UAS Scenarios

- The scenarios (Deliverable 2) shall describe how UAVs might operate in the airspace system at three distinct periods in time; 2015, 2020, and 2025. The role of the human and the role of the UAV's automation shall be explicitly identified in each scenario. Differences in operation based on UAV classification shall be identified and explained such as the role of humans or the automation as the UAV's characteristics (such as size) change.

State of the Art (SOA) Assessment

The "UAS State of the Art (SOA) Assessment" is a NASA document that is being produced by the UAS team. Technical input is provided from each of the work elements and consolidated into a final draft document. Although the consolidated "UAS SOA Assessment" document is produced outside this task, the contractor shall review and provide comments to the consolidated UAS SOA assessment.

- Final version (Deliverable 4) of the "State of the Art (SOA) UAS Report" shall include existing and potential future procedures for all classes of UAS. The report shall also include the gap analysis between existing and future procedures with any attendant R&D requirements to bridge the gap.

UAS Classification System

- The Classification System (Deliverable 3) is an important systems engineering analysis of the full range of possible UAS vehicles from very large to very small. Because UAS's can cover such a large range of sizes, and size can have such a large affect on the capabilities of the vehicle, this framework is essential to the development of the roadmap. The contractor shall identify key parameters that capture all aspects of basic UAS design and in the context of airspace operations, organize the design space accordingly. It is important to capture at what critical design point does the operation of the UAS no longer (if ever) need regulation and at what other points in the design space does the regulatory framework change if ever.

R&D Roadmap

The R&D Roadmap (Deliverables 5-8) shall be revised and developed over several months as the contractor incorporates input from other contractors and government teams working on related aspects of the research plan. The contractor shall organize this information utilizing a systems engineering approach into a technology-oriented research & development roadmap.

- The Draft R&D Roadmap (Deliverable 5) will identify level I (highest level) milestones and goals & objectives with an initial cost estimate. Each successive iteration (Deliverables 6-7) shall add additional layers of detail to the milestones and resource estimates so that the final R&D roadmap includes three-level of milestones along with detailed resource, workforce, and facility needs identified.

- The Final R&D Roadmap (Deliverable 8) shall include the future scenarios and the UAS classification system, so that the three-levels of milestones and resources identified address each technology gap within each UAS class. For each class of UAS, the milestones shall identify research & development to be performed in order to raise the TRL from the current level to TRL 6. Milestones shall be grouped in 5-yr blocks in accordance with the future scenarios for the 2015, 2020, and 2025 timeframes.

- The final R&D roadmap shall be presented to the UAS Project Team prior to NASA approval. (See Milestone B).

3.2 Sense & Avoid Requirements Study

The contractor shall conduct a simulation study to identify the initial sense & avoid requirements for unmanned aircraft. The contractor shall incorporate accurate UAV models into a flight simulation in order to study aircraft scenarios involving both manned and unmanned aircraft. The study shall focus on the minimum equipage needed by UAVs to detect and avoid other aircraft autonomously, or without human assistance. The study shall specifically look at the tradeoff between minimal equipage for all aircraft versus the sensors needed by UAVs to detect unequipped aircraft. The contractor shall address all classes of UAVs in the study and propose follow-on flight experiments to validate the results of the simulation.

The following deliverables shall support the task.

Ref	Deliverable Description	Due Date	Completion Criteria
1	"Sense & Avoid Requirements" Work Plan	3 weeks after task award	Schedule and metrics for Deliverable 2 are complete
2	Sense & avoid requirements simulation study completed	9/2010	See Section 3.2 and technical acceptance measurement below.
3	Monthly progress report	Monthly	See requirement below (ref 4.2)

Technical Acceptance Measurements

The government shall have two weeks to evaluate all deliverable submissions and shall use the following to determine technical acceptance of deliverables.

"Sense & Avoid Requirements" Work Plan

- "Sense & Avoid Requirements" work plan (Deliverable 3.2.1). The contractor shall prepare and present a work plan/task plan which outlines their proposed schedule and metrics for satisfying each of the deliverables listed below. This plan shall be presented to the government for approval within three weeks of contract award or in accordance with the task order clause of the contract. Any change to the work plan/task plan shall be mutually agreed to by the government and the contractor.

UAS Sense & Avoid Requirements Study

- The UAS sense & avoid requirements simulation study shall address the autonomous collision avoidance capability desired in terms of sensor and algorithm requirements (Ex. detection threshold range for various weather conditions) based on UAV maneuverability, speed, size, and equipage. The study shall address all classes and sizes of UAS from very large to very small as identified in task 3.1. The simulation study results shall be presented to the UAS Project Team prior to the report's final approval by NASA. (See Milestone C).

4.0 Special Requirements

Please check if any of the following special requirements are anticipated.

Requirement	Affects Task?		Clarification
Export Control	☐ Yes	☑ No	N/A
Proprietary	☐ Yes	☑ No	N/A
Organizational Conflict of Interest (OCI)	☐ Yes	☑ No	N/A
Government Furnished Equipment	☐ Yes	☑ No	N/A
Other	☑ Yes	☐ No	The government will provide current versions of the NextGen CONOPS. The state-of-the-art assessment & gap analysis will also be provided.

4.1 Recovery Act Requirements for this Recovery Act funded procurement action are addressed at the contract level or at the task order level:

4.1.1 If ARRA requirements are carried at the contract level, they can be found in Sections G, H and I of the contract

4.2 Monthly Progress Reports

The Contractor shall submit separate monthly reports of all work accomplished during each monthly period

of contract performance. These reports shall include (at a minimum) the following:

(a) Quantitative description of progress.

(b) An indication of any current problems that may impede performance.

(c) Proposed corrective action.

(d) A discussion of the work to be performed during the next monthly reporting period.

The Monthly Technical Progress Report shall be submitted within 10 business days after the end of each monthly report period.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): NONE

6. Period of Performance:

Planned start date: TBD Completion date: Twelve months from issue. (TBD)

7. NASA Task Management:

Technical Monitor (Required): James R. Burley II

M/S: 254 Phone: 757-864-2008

TASK ORDER NUMBER: 082D3-NNL10AM01T Revision: 0 Change: 0 Date: October 8, 2009
Title Flow Simulations and Grid Generation Support for Airframe Noise Research in CASB

1. Purpose, Objective, or Background (Optional)

The focus of this task is to provide Computational Fluid Dynamics (CFD) analyses to Computational AeroSciences Branch (CASB) in support of NASA missions. The Computational AeroSciences Branch of the Research and Technology Directorate is responsible for performing computational research in aerodynamics and acoustics with applications in all speed regimes, from subsonic to hypersonic flight. The branch works to improve the fundamental understanding of physics associated with the fluid mechanics and noise generation for complex airframe systems. CASB is also responsible for performing Computational Fluid Dynamics (CFD) analyses of various classes of vehicles in support of NASA missions. Skills for this work currently reside in Task Order NNL08AM06T.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

The scope of this work is to provide CFD analysis and grid generation support for the Environmentally Responsible Aviation (ERA) project in the Computational AeroSciences Branch (CASB) of the Research and Technology Directorate. CASB is responsible for the generation of steady and unsteady aerodynamic database for the regional jet class of configurations. The aerodynamic database is critical for performing aeroacoustic analysis of the regional jet aircraft and for developing viable noise reduction concepts to mitigate airframe noise component of aircraft noise. CFD tools employed for these analyses include FUN3D and CFL3D solvers for flow analysis and TetrUSS unstructured grid generation tools, VGRID and GridTool.

The Contractor shall perform the following requirements:

Contract Paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATION (NOCs) applies to this task order. As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor.

2.1 (NOC) Unstructured Grid Generation and CFD Analysis:

2.1.1 The Contractor shall construct unstructured computational grids for accurately modeling aerodynamic flow around the 18% semi-span model of the G550 aircraft both in closed-wall wind tunnel and free field configurations. Grid requirements and specifications will be provided to the Contractor on a case-by-case basis. An expert knowledge of the TetrUSS unstructured grid generation tools, VGRID and GridTool, is required for this task as these tools shall be used in construction of the required grids.

2.1.2 Using the grids generated in 2.1.1, the Contractor shall set up the steady cases and run CFD code to acceptable level of convergence and post-process the results in graphical and report form. The test cases and flow conditions will be provided to the Contractor on a case-by-case basis. An expert knowledge of the FUN3D suite of software along with its pre- and post-processing capabilities shall be provided as this unstructured CFD code shall be used to generate the required solutions for the configurations provided.

2.1.3 Using the unstructured grids generated in 2.1.1, the Contractor shall set up the unsteady cases for high-fidelity simulations of the aerodynamic flow around the 18% semi-span model of the G550 aircraft. The test cases and flow conditions will be provided to the Contractor on a case-by-case basis. The Contractor shall run CFD code to acceptable level of convergence and post-process the results in graphical and report form. An expert knowledge of the FUN3D suite of software along with its pre- and post-processing capabilities

shall be provided as this unstructured CFD code shall be used to generate the required solutions for the configuration provided.

2.1.4 The Contractor shall extract the following quantities from the time-accurate solutions and make comparison with available experimental data

a) time-averaged surface C_P
b) rms of surface C_P'
c) time-averaged velocity field near the inboard and outboard flap tips and winglet
d) rms of the velocity fluctuation at the inboard and outboard flap tips and winglet
e) 2-D and 3-D time-averaged turbulent kinetic energy near the inboard and outboard flap tips and winglet

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Specific deliverables and completion dates for the work breakdown elements are given below.

ELEMENT	DELIVERABLE	DATE
1.1	Grid generated for the specified configurations in electronic format, applicable results files, and any subsidiary files necessary to run the CFD code using the generated grid.	As noted in NOCs.
1.2	CFD solutions generated using the grids in 2.1.1 or provided by NASA, in electronic format as specified.	As noted in NOCs.
1.3	Analysis reports documenting the work, assumptions, requirements, cases run, results, issues and solutions.	As noted in NOCs.
1.4	Charts, tables, documents and electronic media documenting Contractor methods and results.	As noted in NOCs.
1.5	Source code (such as Fortran or C++) developed to automate running required cases, analyzing results, or to support any CASB task.	As noted in NOCs.
1.6	Miscellaneous charts, tables, documents, photographs, and other data required for documentation of the results.	As noted in NOCs.
n	Prevention and correction of cited findings.	Ongoing

NOTE: The Contractor shall coordinate specific interim due dates with the Technical Monitor

- Review meetings when the Contractor has completed work specified under work elements 2.1.1, 2.1.2, 2.1.3 and 2.1.4.
- Final report shall be provided by the task completion.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

For the above listed deliverables, Meets Requirements will be defined as delivery by the coordinated due date; Exceeds Requirements will be defined as delivery 3 days or more prior to the coordinated due date.

2.n Sub-Task n - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

The government will provide access to CFD codes, grid generation software and high performance computer resources needed for the accomplishment of the assigned tasks. Specifically, access will be provided to the unstructured and structured grid Navier-Stokes codes FUN3D and CFL3D and TetrUSS unstructured grid generation tools, VGRID and GridTool. The Contractor will be responsible for providing computer resources needed for CFD case setup, graphical display of data and report preparation. The 18% semi-span G550 model geometry, the structured grid for the model, and any available experimental data shall be provided to the Contractor in electronic form. The G550 aircraft geometry is proprietary information and therefore, its dissemination to 3rd parties by the Contractor is strictly prohibited.

4. Other Essential Information:

This task order shall be examined for Organizational Conflict of Interest (OCI) concerns. The three-tier review process that was mutually agreed to in Modification 1 to the TEAMS Contract shall be used to conduct this evaluation and shall be used for each NOC as appropriate.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required):

None Needed

6. Period of Performance:

Planned start date: TBD Completion date: 10/31/2010

7. NASA Task Management:

Technical Monitor (Required): **Mehdi R. Khorrami**

M/S: 128 Phone: 4-3630

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 083D3-NNL10AM04T Revision: 0 Change: 0 Date: October 22, 2009

Title: Structured Multiblock CFD Grids on the Trapezoidal Wing

1. Purpose, Objective, or Background (Optional)

Creation and delivery of 5 structured multiblock one-to-one grids on the trapezoidal wing configuration for use in the 1st CFD High Lift Prediction Workshop. A known source for this work is Pointwise, Inc. (Fort Worth, TX).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 Create 5 structured multiblock one-to-one grids on the trapezoidal wing configuration (ref: http://hiliftpw.larc.nasa.gov):

Note: See above website for Configurations 1 and 8.

The Contractor shall create a coarse mesh on Configuration 1, containing approximately 10 million elements and having a wall spacing of dy=0.00020 inches.

The Contractor shall create a medium mesh on Configuration 1, containing approximately 28 million elements and having a wall spacing of dy=0.00013 inches.

The Contractor shall create a fine mesh on Configuration 1, containing approximately 80 million elements and having a wall spacing of dy=0.00009 inches.

The Contractor shall create an extra fine mesh on Configuration 1, containing approximately 226 million elements and having a wall spacing of dy=0.00006 inches.

The Contractor shall create a medium mesh on Configuration 8, containing approximately 28 million elements and having a wall spacing of dy=0.00013 inches.

The Contractor shall create all grid block and patch dimensions consistent with multi-grid solver usage.

The Contractor shall follow the gridding guidelines provided in the "Gridding Guidelines" document on http://hiliftpw.larc.nasa.gov.

The Contractor shall follow industry-standard quality CFD meshing practices.

The Contractor should create the Configuration 1 series of grids with consistent quality refinement between coarse, medium, fine, and extra fine levels: each index in each direction on all blocks should be made finer by a reasonably consistent factor, from one grid to the next finer one.

2.1.1 Milestones (Optional): None.

2.1.2 Deliverables and Schedule (Required):

The Contractor shall deliver the 5 grids by January 31, 2010. The Contractor should provide all grids in CGNS format, with connectivity and boundary condition information included. If machine resources are exceeded for CGNS on the finest grid(s), then the finest grid(s) shall be delivered in PLOT3D format, with connectivity and boundary condition information provided separately. Gridgen V15 restart files shall be delivered for each of the 5 grids.

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

Exceeds: Quality objectives exceeded in "Description of Work."

Meets: Quality objectives met in "Description of Work."

2.1 Sub-Task 1 - Working Environment Safety and Organization (Required)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.1.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.1.2 Required date: Ongoing.

2.1.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: None.

4. Other Essential Information: None.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): None.

6. Period of Performance:

Planned start date: 11/5/2009 (TBD at Task Issuance) Completion date: 1/31/2010

7. NASA Task Management:

Technical Monitor (Required): **Chris Rumsey**

M/S: 128 Phone: 757-864-2165

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 084D3-NNL10AM05T Revision: 0 Change: 0 Date: November 3, 2009
Title: **Research and Development to Mature Airborne Self-Separation Algorithms and Concepts**

1. Purpose, Objective, or Background (Optional)

The Next Generation Air Transportation System (NextGen) concepts of operation (http://www.jpdo.gov/nextgen.asp) require aircraft to fly planned trajectories in four dimensions – three spatial dimensions and time. A prototype 4-Dimensional flight management capability is being developed by NASA to facilitate the development of these concepts. The NASA 4-Dimensional Flight Management System (4D-FMS), developed for NASA under contract NNL07AA00B, provides a cornerstone for airborne-based Self Separation and Air Traffic Management research and development at NASA Langley. The 4-Dimensional Flight Management System (4D-FMS) will have new trajectory generation functions that extend today's Flight Management System (FMS) capabilities that meet a single Required Time of Arrival (RTA). The objective of 4D-FMS is to generate trajectories with multiple waypoints that have Required Times of Arrival. When it is not possible to generate a trajectory that meets all of the RTA constraints, a constraint management capability relaxes constraints to achieve a trajectory solution that meets the most important constraints, as specified by the (NextGen concepts. The new software flight guidance functions provide continuous guidance to the simulated aircraft's flight control system to enable it to fly a specified 4-Dimensional trajectory. The 4-Dimensional Flight Management System (4D-FMS) will be integrated into NASA's Airspace and Traffic Operations Simulation (ATOS), which is hosted in NASA Langley's Air Traffic Operations Laboratory (ATOL). The NASA Langley Air Traffic Operations Laboratory (ATOL) houses a suite of complex, high-fidelity simulation systems dedicated to the research of advanced Air Traffic Management (ATM) concepts and technologies including self-separation.

This effort will be funded using the American Recovery and Reinvestment Act (ARRA) funding, hereinafter referred to as "Recovery Act." The Recovery Act's purpose is to provide a stimulus to the US economy and, among other provisions, funds to Federal Agencies for use on contracts and assistance agreements. Consequently, use of the funds is limited to projects that demonstrate, among other things, the potential to deliver programmatic results and achieve economic stimulus by optimizing economic activity and the number of jobs created or saved in relation to the dollars obligated. Reporting on ARRA tasks and costing shall be in accordance with the terms and conditions of the basic contract NNL07AA00B.

This task order is to be completed 12 months after contract award.

Objective:
The objective of this task is to design and implement full documentation of the 4-Dimensional Flight Management System (4D-FMS) software. The document will be utilized to facilitate technology transfer.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)
4-Dimensional Flight Management System (4D-FMS) documentation
Requirements:

The Contractor shall develop documentation for existing and enhanced 4D-FMS software. The documentation shall be in accordance with NPR 7150.2 "NASA Software Engineering Requirements," and shall include, but is not limited to, the items listed below:

1. How the 4D-FMS functions and its capabilities (Software functional architecture and logic)
2. 4-Dimensional Flight Management System (4D-FMS) interfaces including:
    a. Input/interface requirements, such as Flight Management System (FMS) trajectory information, aircraft state data, and other appropriate information from the aircraft's avionics data bus
    b. Configuration Files and command line options
    c. Output (to Multi-function Control Display Unit), data logging and modes of operation
    d. Performance considerations and system requirements for 4D-FMS

The Contractor shall propose the specific documentation format, level of detail, and storage media for delivery to the NASA Task Monitor (TM). NASA will provide the Contractor with a standard template for software documentation to use as a baseline example. After TM approval of the required documentation level of detail, format, and storage media for delivery, the Contractor shall proceed with the document development.

2.1 CONTRACT TASK DELIVERABLES:

Number	Deliverable Item	Deliverable Schedule after start of task
1	Recovery Act reporting status updates	In accordance with the contract
2	Informal Technical Status Reports	Weekly
3	Monthly Technical Progress/Schedule Reports	Monthly
4	533 Reports	Monthly
5	Proposed documentation format, level of detail, and storage media for the 4D-FMS documentation. (in accordance with NPR 7150.2)	1 month (NASA will return comments within 5 business days of the proposal)
6	Preliminary Draft 4-Dimensional Flight Management System (4D-FMS) documentation	6 months

7	Informal final accomplishment review (description of the task, approach for accomplishment, and what was accomplished)	9 months
8	Draft final scientific and technical report (NFS 1852.235-73) 4-Dimensional Flight Management System (4D-FMS) documentation	10 months
9	Final scientific and technical report (NFS 1852.235-73) 4-Dimensional Flight Management System (4D-FMS) documentation	12 months

2.1.1 Performance Metrics/Standards (Required - Meets, Exceeds, Fails):

a. Performance Standard: All deliverables (not including status reports) are submitted in a timely manner.

Performance Metrics:
EXCEEDS: All deliverables are delivered in advance of the due date.
MEETS: All deliverables are delivered on the due date.
FAILS: At least one deliverable is not delivered on the due date.

b. Performance Standard: All required information for each status reporting deliverable is provided.

Performance Metrics:
MEETS: Status reporting provides all required information for each status reporting deliverable, with some or no errors, and is provided on the due date.
FAILS: Status reporting: does not contain all required information for each status reporting deliverable, contains significant editorial errors, is repeatedly (more than 2 occurrences) provided after the due date, or is provided later than 3 business days after the due date.

c. Performance Standard: 4D-FMS documentation: complies with the requirements of 7150.2, contains approved items at the agreed level of detail, is understandable, and is up-to-date.

Performance Metrics:
EXCEEDS: Documentation complies with the requirements of 7150.2, contains approved items with at least the agreed level of detail, is understandable, is up-to-date, and has no technical or editorial errors.
MEETS: Documentation: complies with the requirements of 7150.2 contains approved

items with the agreed level of detail, is understandable, is up-to-date, contains no technical errors, but has some editorial errors.

FAILS: Documentation: does not comply with the requirements of 7150.2, does not contain one or more approved documentation items, contains technical errors, or significant editorial errors.

2.2 WORKING ENVIRONMENT SAFETY AND ORGANIZATION

The Contractor shall maintain the working environment of accessed facilities and equipment as safe and organized to the extent the support required in this task order will allow.

2.2.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.2.2 Required date: Ongoing.

2.2.3 Performance Metrics:

EXCEEDS: No cited findings or reportable incidents in six-month award fee period.

MEETS: No repeated findings or incidents in six-month award fee period.

FAILS: Repeated finding or incidents in six-month award fee period.

3. Government Furnished Items:

1. NASA Innovative Partnership Program Seed Fund Proposal, "Four-Dimensional Flight Management to support the Next Generation Air Transportation System (NGATS)"
2. Requirements document, "Capabilities Required for Research Prototype Four Dimensional FMS, Version 1.0."
3. Ballin,M., Williams,D., Allen,D., Palmer, M., October 26-30, 2008, Prototype Flight Management Capabilities to Explore Temporal RNP Concepts, 27th Digital Avionics Systems Conference, IEEE/AIAA
4. Standard Format for Software Documentation

4. Other Essential Information:

None

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines. The Contractor shall comply with NASA security requirements applicable to employment of foreign nationals.

6. Period of Performance:

Planned start date: NLT November 01, 2009 (TBD) Completion date: 12 Months after contract award (TBD)

7. NASA Task Management:

Technical Monitors (Required):

Michael D. Guminsky
M/S: 156A Phone: 757-864-9579
Stephen L. Ruggles
M/S: 156A Phone: 757-864-1515

TASK ORDER NUMBER: 085D3-NNL10AM06T Revision: 0 Change: 0 Date: November 9, 2009

Title: Discrete Roughness Element Technology (DRE) Extension to Higher Reynolds Numbers

1. Purpose, Objective, or Background (Optional)

The objective for the research is to investigate, in a low-disturbance, flight-test environment, spanwise-periodic discrete roughness element technology (DRE) on a swept-wing test article in a chord Reynolds-number regime of 15 – 25 million and in the transonic Mach number regime of 0.75 – 0.8. In the ongoing laminar-flow-control (LFC) flight research work being conducted at Texas A&M University DRE technology to control crossflow-induced transition has been demonstrated in the lower Reynolds-number rangime of 7-8 million. The work to be conducted under this task will extend the DRE technology to higher Reynolds numbers.

The test article will be designed to be mounted as a wing glove on an aircraft to be selected by NASA, in a shape consistent with achieving significant regions of natural laminar flow while having a 30º leading edge sweep. The goals are to quantify the effectiveness of DRE in increasing the extent of laminar flow on the lower and/or upper surface beyond the baseline (no-control) case; investigate the robustness and utility of DRE in maintaining laminar flow over variations in lift coefficient (C_L) and angle-of-attack (*AoA*); gain insight into conducting boundary layer LFC experiments in a realistic flight environment; obtain a database that provides validation and prediction tools for boundary-layer stability and transition; and provide a test platform for evaluating the effectiveness of LFC in an operational environment.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

2.1 NLF Glove Design and Instrumentation Layout:

The Contractor shall design a wing-glove for natural laminar flow flight testing in the transonic Mach number regime (between 0.75 and 0.8), and to demonstrate effectiveness of the DRE technology, with following specifications:

- The glove shall be sized to fit on the wing of the aircraft to be specified by NASA
- The range of chord Reynolds number to be considered, 15-25 million
- The range of lift coefficients (C_L) and angle-of-attacks (*AoA*) typical of transonic aircraft

The Contractor shall perform all the computations (Computational Fluid Dynamics for the aircraft, stability analysis, etc.) necessary for the design of the glove. The Contractor shall specify critical tolerances (surface roughness, waviness, etc.) required for manufacturing of the glove.

The Contractor shall specify all the instrumentation required for acquiring necessary information for transition detection and comparison of the data with computational predictions. The instrumentation shall include, but not be limited to, pressure ports, global imaging techniques, surface hot-films, dynamic pressure sensors, and probes for measuring free-stream disturbances. Layout of the instrumentation on the wing-glove shall also be designed. Instrumentation shall not have any adverse effect on boundary-layer transition.

Contractor shall also work with the NASA team in a consultative role in the design of the flight experiment and participate in all the reviews required for successful planning, glove construction and conduct of the

flight test for demonstration of DRE technology

2.1.1 Deliverables and Schedule:

Contractor shall participate in all reviews and teleconferences scheduled by NASA during the period of performance.

Contractor shall complete glove design and deliver data required for glove construction within 120 days from the date of selection of the aircraft by NASA, not including the time required for laser scanning to generate three-dimensional model of the aircraft.

Contractor shall provide a final report containing the NLF glove design containing the design process and the complete geometry required for construction of the glove and surface finish requirements necessary for achievement of NLF on the designed glove. The report shall include specification and design of instrumentation layout as well as all the necessary data required for glove manufacturing. The data shall be submitted as required by NASA to align with its flight test schedule. Final report shall be delivered no later than 2 months prior to the end of the period of performance.

2.1.2 Performance Metrics/Standards:

Meets: All data and reports submitted on schedule.
Exceeds: All data and reports submitted 7 days before the required date.
Meets: Laminar flow up to 50% (upper surface) and 40% (lower surface) of the wing chord.
Exceeds: Laminar flow up to 60% (upper surface) and 50% (lower surface) of the wing chord.

2.n Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items: None

4. Other Essential Information: Discrete Roughness Elements (DRE) technology was developed by Professor William Saric of Texas A&M University and he holds unique expertise in this specialized area. Government considers Professor Saric's direct involvement in this effort essential for the successful

demonstration of the DRE technology.

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): None

6. Period of Performance:

Planned start date: November 16, 2009 (TBD) Completion date: November 15, 2010

7. NASA Task Management:

Technical Monitor (Required): **Mujeeb R. Malik**
M/S: 128 Phone: (757) 864-6228

Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 086D3-NNL10AM07T Revision: 0 Change: 0 Date: November 16, 2009
Title: **Research and Development to Conduct Air-ground Functional Allocation Studies**

1. Purpose, Objective, or Background (Optional)

The NASA Next Generation Air Transportation System (NextGen) - Airspace Project, under the Airspace Systems Program (ASP), directly addresses the fundamental air traffic management (ATM) research needs for NextGen (www.jpdo.gov/nextgen.asp) by developing revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of the National Airspace System (NAS).

Functional allocation of roles and responsibilities in Air Traffic Management has been identified as a research thrust (area of significant interest) for NASA's Separation Assurance (SA) focus area. The SA focus area is concerned with the separation of air traffic, conflict detection of aircraft trajectories, and resolution of any conflicts. Key issues within SA are the division of responsibility between automation and humans and between aircraft operators and air traffic service providers. This new thrust is supported by cooperative planning and research between NASA Langley and NASA Ames and, so, demands common scenarios, metrics, assumptions and comparable capabilities. To this end, the current fleet of Aircraft Simulation for Traffic Operations Research (ASTOR) aircraft will be augmented with new aero-performance models to increase simulation capability and fidelity, and enhance functional allocation research and experiments conducted in NASA's Air Traffic Operations Laboratory (ATOL).

This effort will be funded using the American Recovery and Reinvestment Act (ARRA) funding, hereinafter referred to as "Recovery Act." The Recovery Act's purpose is to provide a stimulus to the US economy and, among other provisions, funds to Federal Agencies for use on contracts and assistance agreements. Consequently, use of the funds is limited to projects that demonstrate, among other things, the potential to deliver programmatic results and achieve economic stimulus by optimizing economic activity and the number of jobs created or saved in relation to the dollars obligated. Reporting on ARRA tasks and costing shall be on a monthly basis in accordance with the terms and conditions of the basic contract NNL07AA00B.

This task order is to be completed by 12 months after contract award.

Technical Direction 1 (12/3/09): Updates the initial task order start date to December 3, 2009 and the completion date to December 2, 2010 as issued by the CO on 12/3/09 (see [TD1] below, Section 6).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

Aircraft Simulation for Traffic Operations Research (ASTOR) Aircraft Models

Background:
The NASA Langley Air Traffic Operations Laboratory (ATOL) houses a suite of complex high-fidelity simulation systems dedicated to the research of advanced Air Traffic Management (ATM) concepts and technologies for NASA's Airspace Systems Program. Currently, the Aircraft Simulation for Traffic Operations Research (ASTOR) only holds a single aircraft aerodynamic performance model (B757) that represents a commercial heavy transport. To perform future research involving air-ground functional

allocation, multiple aircraft models will be required to investigate the interactions of multiple aircraft types with different climb/cruise/descent behaviors.

Objective:
The objective is to convert aerodynamic performance and engine data of multiple aircraft into Aircraft Simulation for Traffic Operations Research (ASTOR) simulation models. The following aircraft models are desired in the Aircraft Simulation for Traffic Operations Research (ASTOR): CRJ-200, B737-300, B737-800, B747-400, B767-200, B777-200, Cirrus SR22, Predator Unmanned Aerial System (UAS) and Global Hawk UAS. For each of these aerodynamic performance models, the government will provide basic lift, drag, thrust and fuel flow data.

Requirements:

The Contractor shall submit proposed software changes to a review process led by NASA Langley's Airspace and Traffic Operations Simulation (ATOS) Lead Systems Engineer, which may include both design and code-level reviews. The Contractor shall also follow the NASA processes for the testing of any modifications and for the revision control of these modifications as they are eventually merged into the baseline code.

The Contractor shall perform the following subtasks:

Subtask 1: Design a Software Solution

a. Generate an Airspace and Traffic Operations Simulation (ATOS) Software Implementation Plan and Software Project Management Plan Document. The document template will be provided by NASA.

b. Create a class level design document to include C++ source code skeletons at the class and interface level and present these structures in a Unified Modeling Language (UML) class diagram format with documentation.

c. Prepare and present the design in a Preliminary Design Review to the Airspace and Traffic Operations Simulation (ATOS) Architectural Group for approval. NASA will provide comments and or approval within one week.

Subtask 2: Implement the Approved Software Design

a. Create new aircraft simulation models (CRJ-200, B737-300, B737-800, B747-400, B767-200, B777-200, Cirrus SR-22, Predator UAS, and Global Hawk UAS) from airplane performance data to increase simulation realism for the Aircraft Simulation for Traffic Operations Research (ASTOR);

b. Develop in C++ source code any additional capabilities necessary to support interactions of the

Airspace and Traffic Operations Simulation and new aircraft simulation models.

Subtask 3: Test the Solution Implementation

a. Develop a unit test in source code to verify functionality of the aircraft simulation models.

b. Develop Airspace and Traffic Operations Simulation (ATOS) regression test scenarios to verify functionality of the aircraft simulation models.

Subtask 4: Integrate the Solution in the Airspace and Traffic Operations Simulation (ATOS) Developmental Software Baseline

a. Prepare a review of all implemented functionality and present to the Airspace and Traffic Operations Simulation (ATOS) Architecture committee in a Critical Design Review. NASA will provide comments and or approval within one week.

b. Submit source code to Airspace and Traffic Operations Simulation (ATOS) integration team for regression testing in the Airspace and Traffic Operations Simulation (ATOS) software baseline. Any omissions, defects or errors in the submitted software are the responsibility of the contractor on this task. The ATOS integration team will verify these new capabilities do not adversely affect the operation of other existing ATOS components. Any adverse effects to other components of ATOS are the responsibility of the contractor on this task to solve and remedy. If an error in an existing capability is found in the ATOS software then the ATOS development team will be responsible for resolution. Any determination of defect will be conducted by the ATOS integration team lead (Technical Monitor).

c. Demonstrate correct software functionality in an integrated ATOS build in the ATOL.

2.1 Contract Task Deliverables**:**

Number	Deliverable Item	Deliverable Schedule after start of task
1	Recovery Act reporting status updates	As specified in the contract
2	Informal Technical Status Reports	Weekly
3	Monthly Technical Schedule Reports	Monthly
4	533 Reports	Monthly
5	Software Project Management Plan (SPMP) for proposed software development (See LMS-CP-5528)	1 month

6	Informal final accomplishment report (description of the task, approach for accomplishment, and what was accomplished)	11 months
7	Final scientific and technical report (NFS 1852.235-73) documenting the research and development efforts and all aircraft simulation models	12 months

2.1.1 Other Deliverables and Schedule (Required)

Deliverables:

Number	Deliverable Item	Deliverable Schedule after start of task
1	Software Implementation Plan for new aircraft simulation models	1 month
2	Class level design document	1 ½ months
3	Preliminary Design Review documentation	2 months
4	Regression Test Scenario Files for aircraft simulation model integration into the Aircraft Simulation for Traffic Operations Research (ASTOR) and Airspace and Traffic Operations Simulation (ATOS) environments.	5 months
5	Critical Design Review documentation	7 months
6	Unit test source code files	8 months
7	Airspace and Traffic Operations Simulation (ATOS) source code modifications and additions	10 months
8	Demonstration in ATOL ensuring proper operability of integrated aircraft simulation models	10 months
9	Documentation for all simulation models (included in the final scientific and technical report)	11 months
10	Aircraft simulation models (CRJ-200, B737-300, B737-800, B747-400, B767-200, B777-200, Cirrus SR-22, Predator UAS, and Global Hawk UAS) developed from airplane performance data.	11 months

2.2 Performance Metrics/Standards (Required - Meets, Exceeds, Fails):

a. Performance Standard: All deliverables (not including status reports) are submitted in a timely manner.

Performance Metrics:
EXCEEDS: All deliverables are delivered in advance of the due date.
MEETS: All deliverables are delivered on the due date.
FAILS: At least one deliverable is not delivered on the due date.

b. Performance Standard: All required information for each status reporting deliverable is provided by the due date.

Performance Metrics:
MEETS: Status reporting provides all required information for each status reporting deliverable, with some or no errors, and is provided on the due date.
FAILS: Status reporting: does not contain all required information for each status reporting deliverable, contains significant editorial errors, is repeatedly (more than 2 occurrences) provided after the due date, or is provided later than 3 business days after the due date.

c. Performance Standard: Documentation complies with the requirements of NPR 7150.2 (NASA Software Engineering Requirements), is understandable, and is up-to-date.

Performance Metrics:
EXCEEDS: Documentation complies with the requirements of NPR 7150.2, is understandable, is up-to-date, and has no technical or editorial errors.
MEETS: Documentation complies with the requirements of NPR 7150.2, is understandable, is up-to-date, contains no technical errors, but has some editorial errors.
FAILS: Documentation does not comply with the requirements of 7150.2, contains technical errors, or significant editorial errors.

d. Performance Standard: Product quality meets customer's documented requirements and expectations (must conform to aerodynamic performance model data).

Performance Metrics:

EXCEEDS: Product performance exceeds customer's documented requirements and expectations. Product provides service to the customer beyond anticipated use requirements. Customer provides written or verbal communication indicating the same.

MEETS: The product performs as documented in the requirements and meets customer needs. Customer is satisfied with product and uses in the manner intended.

FAILS: Product does not perform as documented in the requirements and customer expectations are not met. Customer is not satisfied with product and cannot use in the manner intended.

2.3 Acceptance Criteria

Delivery of a product is deemed complete once the deliverable has

a) completed a capabilities demonstration witnessed by the customer

b) been submitted into the project's configuration management system (Clear Case) as a configuration controlled item

2.4 Working Environment Safety and Organization

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to the extent the support required in this task order will allow.

2.4.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.4.2 Required date: Ongoing.

2.4.3 Performance Metrics:

EXCEEDS: No cited findings or reportable incidents in six-month award fee period.

MEETS: No repeated findings or incidents in six-month award fee period.

FAILS: Repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

To be provided within one month after contract award.

1. Air Traffic Operations Lab (ATOL), including multi-monitor Windows XP Workstations, peripheral hardware, and lab space for facility configuration and operation
2. Aircraft Simulation for Traffic Operations Research (ASTOR) software.
3. Aircraft and engine performance data and supporting documentation for CRJ-200, B737-300, B737-800, B747-400, B767-200, B777-200, Cirrus SR-22, Predator UAS, and Global Hawk UAS.

4. Other Essential Information:

None required

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete

nondisclosure agreements with NASA, industry, or airlines. The Contractor shall comply with NASA security requirements applicable to employment of foreign nationals.

6. Period of Performance:

Planned start date: [TD1] ***December 3, 2009*** Completion date: [TD1] ***December 2, 2010***

7. NASA Task Management:

Technical Monitors (Required):

Michael D. Guminsky
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Stephen L. Ruggles
M/S: 156A Phone: 757-864-1515

TASK ORDER NUMBER: 015E4-NNL10AM08T Revision: 0 Change: 0 Date: January 6, 2010

Title: **ERA Advanced Concepts Systems Analysis, Vehicle Design, Technology Studies, and Methods Development – HWB Design and Analysis**

1. Purpose, Objective, or Background (Optional)

Both the Subsonic Fixed Wing (SFW) project in the Fundamental Aeronautics Program (FAP), and the Environmentally Responsible Aviation (ERA) project in the Integrated Systems Research Program (ISRP) are actively researching the potential of the hybrid wing body (HWB) concept to provide significant reductions in fuel burn, noise and emissions compared to today's airliners, and future, conventional designs. The Aeronautics Systems Analysis Branch (ASAB) has repeatedly been asked to provide systems analysis support for these HWB research activities. This support requires ASAB to design and analyze HWB concepts across a wide range of mission and technology sets. Over the past several years, SFW has supported tool and method development in this area, resulting in a variety of new tools such as the Boeing CBWT, AVID's HWB planform layout, aerodynamics and structures tools, Cal Poly's aerodynamics tool, in addition to in-house tools such as MaSCoT and HWB FLOPS. This new task order calls for support in evaluating, assembling and utilizing these tools to improve ASAB's HWB design and analysis capability for ERA.

Revision 0 (1-06-2010): Task origination.

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)

The Contractor shall perform the following requirements:

2.1 (Requirement/subtask number one):

1. Perform in depth literature search on HWB design and analysis efforts.
2. Obtain and evaluate currently available HWB design and analysis tools and methods. Propose an HWB design and analysis process and define the supporting toolset.
3. Create the proposed HWB design and analysis process and supporting toolset. Validate the process utilizing existing HWB data to be supplied by NASA.
4. Utilize HWB design and analysis toolset to layout HWB reference vehicles for the following five missions classes:

    a. 98 passenger regional jet mission similar to the ERJ190 (Embraer 190)
    b. 160 passenger narrowbody jet mission similar to the 737-800
    c. 216 passenger wide body jet mission similar to the 767-200ER
    d. 300 passenger wide body jet mission similar to the 777-200LR
    e. 400 passenger jumbo jet mission similar to the 747-400

    Utilize 2020 TRL=6 technologies to size and estimate performance for each of these five HWB designs. In addition to typical sizing constraints, stability and control constraints should be included in the sizing iteration. Two separate optimizations will be provided, one for minimum TOGW (takeoff gross weight), and one for minimum fuel burn.
5. Perform technology sensitivity studies utilizing these five HWB reference vehicles.

2.1.2 Deliverables and Schedule (Required):

Task 1: Written report summarizing results of literature search, including synopses of each significant reference source.
Tasks 2: Written report summarizing each of the tools examined, and the recommended HWB design and analysis process and supporting toolset.
Task 3: Demonstration of HWB design and analysis process on the validation case.
Task 4: Provide VSP or other CAD layout drawings for each of the five HWB reference vehicles, showing internal cabin layout and major subsystems. Provide data on the sized vehicles including performance estimates.
Task 5: Provide written report detailing the results of the technology sensitivity study for each of the five HWB reference vehicles.

Tasks 1-4: Monthly status reports indicating progress to-date, planned near term activities, technical issues, and resource status. Status reports should be no more than one page in outline format, and should be discussed at a monthly status meeting with the technical lead and other HWB design team members.

Due 30 days after start of work: Task 1 written report
Due 120 days after start of work: Task 2 written report
Due 210 days after start of work: Task 3 Demonstration
Due 300 days after start of work: Task 4 HWB concepts
December 31, 2010: Task 5 written report

2.1.3 Performance Metrics/Standard (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")

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 significant reference source and technology projection.

2.n Sub-Task n - Working Environment Safety and Organization
The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to support the requirements of this task order.

2.n.1 Deliverable: Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.n.2 Required date: Ongoing.

2.n.3 Performance Metrics:

Exceeds: No cited findings or reportable incidents in six-month award fee period.

Meets: No repeated findings or incidents in six-month award fee period.

3. Government Furnished Items:

A. Access to government tools relevant to this activity (e.g., FLOPS, VSP, MaSCoT, etc.). ModelCenter software will be provided, along with the HWB literature and validation data.

4. Other Essential Information:

The Contractor shall participate in appropriate technical conferences/short courses to maintain cognizance of new approaches and to refresh skills, as needed, to support the requirements of this task order as coordinated with the Technical Monitor.

NOTE: The Contractor shall place no restrictions on NASA's use or distribution of the models/codes produced under this contract nor distribute them to other parties without NASA's permission.

Note: These codes will only be used for performing the work under this contract and cannot be used for any other purpose or distributed without the permission of NASA, Langley. The Contractor is required to sign a Software Usage Agreement.

5. Security Clearance:

6. Period of Performance:

Planned start date: February 1, 2010 Completion date: December 31, 2010

7. NASA Task Management:

Technical Monitor (Required): Jeffrey K. Viken

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Other POC (Optional): Craig Nickol

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Other POC (Optional):