TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 001C1-NNL07AM00T Revision: 3 Change: 0 Date: November 5, 2008	
Title: R3 ***Technical Experts and Testing support for NESC***	

1. Purpose, Objective, or Background (Follow-on to SAMS task order 01ALA)
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.

R3> ***The purpose of this task order is to provide Technical Experts and services, including testing and***

fabrication, to support NESC assessment teams, SPRTs, the Deputy Director for Safety and NCEs. <R3

Revision 1: Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support requirements, notes the anticipated CCM requirement in Subtask 2.5, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007 (see R1 below).
Revision 2 (2/04/08): Clarifies safety and organization Subtask 2.n and requests new estimate for increased NOC activity. (see R2 below).
Technical Direction 1 (4/2/08): Adds new primary Technical Monitor (TM) and keeps the previous TM as Alternate (see TD1 Section 7, below).
Revision 3 (11/5/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support requirements, removes the support requirements identified in subtasks 2.2, 2.3,and 2.4 to continue under a new task order, and updates the task order title and other information (see R3 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) 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 Technical Expertise: The Contractor shall provide appropriate technical experts to participate in and significantly contribute to the findings and operations of NESC assessment teams, SPRTs, Deputy Director for Safety and NCEs. The Contractor shall perform technical analyses 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.

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

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

2.2 Project Coordination and Planning: R3***(Deleted)***

2.3 Project Communication: R3***(Deleted)***

2.4 Document Preparation: R3***(Deleted)***

2.5 Test Support: The Contractor shall make available appropriate experts to provide testing of hardware components as needed by the NESC teams. The Contractor shall also make available manufacturing services to provide test article hardware fabrication for use in testing and analyses as needed by the NESC teams. These test articles shall conform to the drawings and specifications provided by the NESC. R1One particular instance of the testing support anticipated for CY07-08 is to provide a Composite Crew Module (CCM). R3>***Note: The CCM work begun under this task order is to be continued under new task order 004C1-NNL09AM03T.***<R3

Deliverables and Schedule: Each Contractor-provided test support shall provide written products such as test plans, reports, analysis results, summaries, recommendations, and findings approved by the team leader. The Contractor-provided test article manufacturer shall provide the test article(s) to the specific team as described by the NASA drawings and specifications. The Contractor shall deliver a brief monthly report outlining NESC activities supported and contributions made. All products are to be delivered as established by NOC.

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

R1**2.n Working Environment Safety and Organization:** The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R2support 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. NASA may also provide highly specialized equipment to be used by the Contractor to perform testing and analysis requirements.

Quality Management for Articles Authorized to be Procured Under this Task. Because of special circumstances governing the scheduling of work and selection of sources, during the fabrication of articles required under this task order, LaRC will be responsible for all quality assurance monitoring. The quality assurance employed will normally take precedence over the Contractor's quality program unless specified in advance by NOC. Inspection and acceptance of articles under this task order will be the responsibility of NESC.

4. Other Essential Information:

[R3>]***Technical Experts will be required to travel to team meetings and assessment sites.***[<R3]

5. Security Clearance:

The Contractor and all Contractor personnel performing the requirements described above, including technical experts (section 2.1), will be required to complete appropriate nondisclosure agreements.

6. Period of Performance:

Planned start date: [R1]January 25, 2007 Completion date: [R1]~~December 31, 2007~~
[R3]~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

(Primary)Technical Monitor (Required): [TD1>]**Diana Kerns**
M/S: 105 Phone: (757) 864-8473[<TD1]

Technical Monitor (Required): **Chris Johansen**
M/S: 105 Phone: (757) 864-6077

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 4
TASK ORDER NUMBER: 001H1-NNL07AM01T Revision: 3 Change: 0 Date: April 9, 2009	
Title: **Creativity and Innovative Research Support**	

1. Purpose, Objective, or Background (Optional) (Reference task 01H1 on the SAMS contract. Desire is to retain incumbent staff for this new task.)

This task is to provide support for Creativity and Innovation Research Programs as well as design workshops at Langley. Research conducted under the umbrella of the Creativity and Innovation Initiative is directly related to the Center's overall mission to undertake innovative, high-payoff activities beyond the risk limit or capability of commercial enterprises and deliver validated technology, scientific knowledge and understanding of the Earth's atmosphere.

The Creativity and Innovative Research Program supports researchers in the conduct of revolutionary, high risk, high payoff research. The Center's success is measured by the extent to which research results in an improved quality of life for America. Having accepted the risk to engage in new and rewarding work, researchers are needed to accomplish the most ambitious research objectives in the following areas:

1. Access to Space
2. Aerospace Applications
3. Air Travel
4. Atmospheric Sciences
5. Military/Aircraft Supremacy
6. Planetary Exploration

Design workshops are innovative workshops held for the purpose of developing new strategies, projects, processes, or solutions to technical or organization issues. In a design workshop, a diverse group of people are brought together, and through the help of a facilitator, contribute their knowledge, learn from one another, and collectively design solutions. Effective design workshops often utilize in-front-of-the-group facilitation, as well as, document capture to elicit information from participants, collect, and organize group input and solution design. Design workshops provide LaRC with an independent and informed set of inputs regarding R2>current and<R2 future research, business opportunities, proposal development, and strategic planning.

Revision 1 (5/29/07): Extends the period of performance one year to September 30, 2008 in continuation of NASA's support requirements, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007 (see R1 below).
Revision 2 (3/19/08): Extends the period of performance one year to September 30, 2009 in continuation of NASA's support, updates/clarifies some details, and notes the implementation of NOC feature due to anticipated ad hoc requirements definition (see R2 above and below).
Technical Direction 1 (03/25/09): Updates Technical Monitor info (see TD1 Section 7, below).
Revision 3 (4/9/09): Extends the period of performance one year to September 30, 2010 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)
R2>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.<R2

2.1 (Requirement/subtask number one):
The Contractor shall:

a. Provide complete administrative support to the entire Creativity and Innovative Research Program
b. Maintain the data system for all research and related activities.
c. Provide a leadership role in planning for and designing the implementation of an established archival system for the Creativity and Innovation Initiative.
d. Maintain an archival framework that clearly defines its purpose, goals and type of material to be acquired.
e. Accumulate appropriate records/documents from existing records, organizations or institutions.

f. Ensure intellectual control over archival holdings, knowing what material is available in the archives and its source.
g. Produce/publish records in paper and electronic format.
h. Make archival records/documents available for use by those having a need to know.
i. Work with NASA LaRC to R2>define the type of facilitation and analysis required for design workshops and<R2 jointly determine target attendees for design workshops.
j. Schedule design workshops in appropriate facilities and work with NASA LaRC to establish agendas and desired outcomes.
k. Provide an expert facilitator for design workshops and provide for document capture R2and analysis<R2 support.
a. Make arrangements for required design workshop support including audiovisual support and food and beverage support.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Overall Status reports – monthly
Deliverables for ongoing C&I support:

1. Records of proposals, evaluations and status update shall be provided in paper and electronic format - monthly
2. Archival records/documents updates provided - not later than two (2) months following the selection of C&I Proposals for award.

Deliverables for design session support: R2>(NOC)

3. Attendees list – to be provided not later than seven days prior to design session
4. Agendas – to be provided not later than three days prior to design session
5. Provide Expert Facilitation - during design session(s) R2>as required to meet the problem solving or design needs of the sponsor. Examples of the types of facilitation and analysis support required include, but are not limited to, Scenario Based Planning, Balanced Score Card planning and analysis, Lean Six Sigma, Organizational Design, and System Dynamics.<R2

6. Design session Documentation – proceedings of a design session are to be provided not later than one (1) month following the session.

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

Metrics: Contractor performance will be evaluated for timeliness, efficiency, initiative, thoroughness, and quality of work.

Standards:

Meets minimum acceptable performance will be determined by deliverables on schedule with the appropriate attention to the above metrics.

Exceeds – "Meets" and any of the following:

- Deliverables 1 and 2 earlier than scheduled by at least two weeks
- Deliverables 3 and 4 earlier than scheduled by at least one day
- Deliverable 6 one week
- Other work metrics better than anticipated
- Unsolicited relevant positive comments from attendees

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[<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: The Government will provide a list of target design workshop attendee names and addresses, facilities for the design workshop and documentation support.

Other information needed for performance of task

4. Other Essential Information:

5. Security Clearance: None

6. Period of Performance:

Planned start date: [R1]January 25, 2007 Completion date: [R1]~~September 30, 2007~~ [R2]~~September 30, 2008~~ [R3]~~September 30, 2009~~

	September 30, 2010

7. NASA Task Management:

Technical Monitor (Required): TD1>**Karen L. Freidt**
M/S: 412 Phone: (757) 660-4875<TD1

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

TASK ORDER NUMBER: 002H1-NNL07AM02T Revision: 4 Change: 0 Date: April 20, 2009

Title: **Cost Estimation and External Business Project Planning**

1. Purpose, Objective, or Background (Optional): (This task is primarily a continuation of Task 02OJ on the SAMS contract.)

NASA Langley's Advanced Planning and Partnership Office (APPO) supports business development at the Center. Among other activities, APPO provides Langley's research and engineering community support in estimating and tracking project costs, provides oversight and support to the Center Bid & Proposal process, and offers guidance for the External Business process.

Cost estimation and tracking is provided for on-going projects as well as proposed new projects. The workload is essentially constant in the long term, but estimates for specific projects occur somewhat sporadically. "Project", as used here, may encompass basic research and technology development, the design, fabrication, flight and operation of an unmanned space or aeronautics science mission; a singular instrument to be used on a separately-conceived spacecraft; an aeronautics research test article; or possibly a major modification to an existing flight test aircraft (the aircraft itself being the "test article"). Cost estimates for on-going projects are for mid course review or for updates to projects which were less defined in earlier analyses and should take into account all completed work and incurred costs. Completed project costs are used to enhance the validity of modeling tools and existing data.

The APPO is the External Business Agreement Process Owner responsible for helping bring market intelligence, new opportunities, efficient and effective proposal development for future business, and funding dollars to the Center. In this role, APPO offers project planning guidance to projects to ensure that consistent guidance is applied to the projects in an expedient manner.

Bid & Proposal (B&P) process support for the Center takes into account the Capture of the business opportunity and continues through submittal of the proposal to the customer. The APPO has oversight for the planning and conduct of proposal reviews. The Center B&P process identifies several reviews each proposal team can be tasked to incorporate into their plans. These reviews can utilize NASA and/or outside expertise to provide the best assessment of the proposal. The APPO also supports the proposal teams with administrative support to ensure the quality and consistency of Langley proposals.

Revision 1 (4/5/07): Adds requirements as new sub-task 5, re-designates safety and organization subtask as "2.n", updates the anticipated staffing need for the task order, provides omitted NOC references, and updates the initial task order start date (see [R1] below).
Revision 2 (11/19/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, adds requirements as new sub-task 6, documents an earlier Technical Monitor change along with identification of alternate POC, and clarifies safety and organization Subtask 2.n (see [R2] below).
Revision 3 (4/28/08): Extends the period of performance 9 months to September 30, 2009 in continuation of NASA's support requirements and updates anticipated travel requirements (see [R3] below)
Technical Direction 1 (03/26/09): Updates Technical Monitor info (see [TD1] Section 7, below).
Revision 4 (4/20/09): Adds requirements as a new sub-task 7 and extends the POP one year to September 30, 2010 (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 [R1](NOC) Sub-Task 1 - Deliverable Parametric and Grassroots Cost Estimates

The Contractor shall perform parametric and grassroots cost estimates and analyses on new, on-going or completed projects to include external business agreements and competed business opportunities. The NASA Technical Monitor will identify those projects to be estimated. Each parametric and grass roots cost estimate shall include the products, services and activities as outlined under deliverables.

2.1.1 Milestones (Optional):

N/A

2.1.2 Deliverables and Schedule (Required):

- At least one interview or meeting with the cognizant NASA officials (Principal Investigator and/or Project Manager and design team) for the purpose of exchanging information on project cost expectations. For a parametric study, mission concept and goals, the expected instrument/test article design parameters, the work breakdown structure (WBS), the project schedule, the programmatic and technical cost ground-rules and assumptions, and the known technical characteristics of the instrument/test article would factor into the discussion.

- An information search and historical data collection activity to establish a relevant database from which to model project costs.

- An assessment and, if needed, adaptation of available modeling tools and techniques to assure the best possible relevance to the subject mission/test.

- A presentation of the Contractor's plans for proceeding with the estimate to the cognizant NASA officials, detailing the model intended for use, the completeness and relevance of available information and historical data, and the likely range of accuracy of the ultimate cost estimate. A specific time of delivery of the final estimate shall be included in this presentation.

- A final cost report that incorporates all relevant information; grass-roots estimates for labor and materials; vendor quotes; comparisons to other available estimates; cost risk issues, including probability ranges and sensitivity analyses for particular aspects. The final report should also spread the expected costs across the entire project schedule and identify significant cost drivers. The final report should be presented formally to cognizant NASA officials and provide for a clear understanding of the estimate, the risk and sensitivity analyses, recommendations for improving the design process to achieve better cost estimates and possible recommendations for less costly design alternatives.

- A brief report to the NASA Technical Monitor on what meetings and activities were conducted in support of the completed estimate and which NASA officials were briefed and/or consulted.

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

Metrics (Meets):

- Delivery of or demonstrable progress toward a completed parametric cost estimate at an overall "average" rate of approximately four (4) each year of contract performance, or toward a grass roots estimate at an overall "average" rate of approximately thirty-five (35) each month, or a combination of parametric and grass roots estimates. The concept of "average" rate is to allow for completion of previously begun estimates as well as estimates assigned late in the period that cannot be completed within the period. It is also intended to recognize that assignment of estimates to the Contractor will not, in most cases, be made on a simple one-each-quarter basis for parametric estimates or 35-per-month basis for grass roots, but rather will be based on an "as needed" basis.

- At least one fact finding or information sharing interview for each parametric estimate.

- At least one briefing on the Contractor's intended modeling approach.

- At least one final cost estimate package and briefing.

- At least one report per month to the NASA Technical Monitor on deliveries and supporting activities.

Metrics (Exceeds):

- Delivery of completed parametric &/or grass roots cost estimates at a higher overall "average" rate within the same contract costs.

- More frequent relevant interaction with cognizant NASA officials, such as advisory meetings on design parameters and suggestions for cost reductions.

2.2 [R1](NOC) Sub-Task 2 - External Business Project Planning:

[R1]Note: It is anticipated that this sub-task will not be fully utilized and when needed could be addressed by Contractor staff supporting other sub-tasks with the workload adjusted between the sub-tasks.

The Contractor shall provide project planning guidance on the appropriate process, forms/templates, and personnel required to conduct external business agreements. The Contractor shall collect and compile process metrics for external business agreements. Further, the Contractor shall provide agreement process improvement recommendations, including proposed modifications to the Estimated Price Report Processing System (EPRPS) and related Langley forms, to the NASA Langley Technical Monitor.

2.2.1 Milestones (Optional):

N/A

2.2.2 Deliverables and Schedule (Required):

- A report that incorporates a summary of the relevant external business process metrics; total number of agreements processed, number of agreements by organization, total dollar value, summary of waived costs, processing time per agreement, internal customer survey results, and external customer survey results.

- Meetings with the NASA Technical Monitor or other designated NASA personnel to discuss ideas for needed improvements. The meetings will also provide a forum for describing the status of on-going efforts.

- Documentation of process improvement(s), including impacts to the process and potential benefits

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

Metrics (Meets):

- A report summarizing the relevant external business process metrics shall be submitted quarterly.

- At least one improvement, including documentation shall be submitted to the NASA Technical Monitor in each six month period. The improvement should be of sufficient scope as to merit its immediate adoption into the external business process for Langley Research Center.

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

Metrics (Exceeds):

- Meetings to discuss proposed or planned improvements and progress on current improvements to the NASA Technical Monitor or other designated NASA personnel at a rate that exceeds one in each three month period.

- Improvements, including documentation submitted to the NASA Technical Monitor or other designated NASA personnel at a rate that exceeds one in each six month period.

2.3 (NOC) Sub-Task 3 – Technical Expertise for Reviews

The Contractor shall provide appropriate technical experts to participate in and significantly contribute to reviews. The Contractor shall assist in performing technical and programmatic analysis focusing on one or more of the following areas of interest, appropriate to the particular review: Systems Analysis; Systems Engineering; Electronics; Avionics; Mechanical Systems; Flight Sciences; Human Factors; Optics & Optical Systems; Materials; Structures; Software; Propulsion; Power; Guidance, Navigation, and Control; Thermal Analysis; Failure Modes and Effects Analysis; Reliability, Maintainability, and Quality Assurance; Operations; Safety and Mission Assurance; Risk Management; Project Management; Cost Estimating; and other associated disciplines.

The volume and exact intensity of anticipated reviews for which support is required in the coming year cannot be accurately stated in advance, but external consultant requirements can be established about 1 month prior to the Review. These reviews are short term and take place over approximately a 2-week period. APPO would establish the technical expert requirements to be addressed at each review.

2.3.1 Milestones (Optional):

N/A

2.3.2 Deliverables and Schedule (Required):

Each contractor-provided technical expert shall provide written products such as reports, analysis results, summaries, recommendations, and findings as documented in NOCs and approved by the NASA Technical Monitor or other designated NASA personnel. The Contractor shall deliver a brief monthly report outlining reviews supported and contributions made. All written products are to be delivered as established by NOC.

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

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.

2.4 [R1](NOC) Sub-Task 4 – B&P Document Preparation:

The Contractor shall prepare, review, edit, or rewrite, as appropriate, proposal documentation dealing with advanced technical subject matter that is competition sensitive, using APPO-provided templates and content. The Contractor shall ensure all documents are written for clarity, grammar, punctuation, spelling, capitalization, usage and format, in accordance with approved publication standards. The Contractor shall produce professional quality photographs using a digital camera and/or software processing, illustrations, drawings, technical art and scientific figures containing Greek and mathematical notations, as appropriate, and facilitate production and integration of figures into the documents described above. Further, once the team leader approves the final version of relevant documentation, the Contractor shall be responsible for uploading those documentation products to the defined APPO site.

The volume and exact intensity of anticipated proposal document preparation for which support is required in the coming year cannot be accurately stated in advance. APPO will establish the detailed documentation requirements for each proposal. The Contractor shall maintain a database of potential, current, and past experts in document preparation skills. This database shall be updated independently by the Contractor and shall include information provided by the APPO.

2.4.1 Milestones (Optional):

N/A

2.4.2 Deliverables and Schedule (Required):

Proposal documentation, reports, technical memoranda and presentations shall be delivered according to the schedules approved by the appropriate Proposal Manager.

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

The Contractor will warrant a "meets" rating if all test plans, reports, technical memoranda and presentation slides are delivered complete and on schedule.

The Contractor will warrant an "exceeds" rating if all requested products are delivered within one or more working days ahead of schedule.

Begin [R1] block addition

2.5 Sub-Task 5 – Cost Model and Technique Development

The Contractor shall investigate new cost modeling tools and techniques and make specific recommendations to the NASA Technical Monitor. Further, the Contractor shall locate and compile historical cost data for relevant space and aeronautics projects. (These accomplishments are referred to as "improvements" in the rest of sub-task 5.) Improvements include cost models and analysis tools for preparing inputs to the cost models as well processing output from the cost models.

2.5.1 Milestones (Optional):

N/A

2.5.2. Deliverables and Schedule (Required):

- In coordination with the NASA Technical Monitor, incorporate new algorithms and methods into existing cost tools. *Ongoing*

- In coordination with the NASA Technical Monitor, design and code new cost estimating tools, including tools to quantify cost risks and estimate probability ranges for model results. *Ongoing*

- Meetings with the NASA task monitor to discuss NASA project needs and ideas for needed improvements. The meetings will also provide a forum for describing the status of on-going efforts. *Ongoing*

- A report detailing each significant improvement made to estimating tools, techniques or databases. Each improvement report should clearly describe the improvement itself, the effort and approach utilized to attain the improvement and the types of projects most likely to benefit from the improvement. The report should be written such that it will be easily understood by non-technical NASA personnel, as well as project investigators and engineers, and should be ready for various methods of informal publication throughout Langley Research Center and, in some cases, other NASA centers. *Ongoing*

- Documentation of the agreed upon improvements, including instructions for its use and examples of its possible application. *Ongoing*

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

Metrics (Meets):

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

- For agreed upon improvements, actual software, documentation and reports detailed above will be submitted to the NASA Technical Monitor per an agreed to schedule.

Metrics (Exceeds):

- Meetings to discuss proposed or planned improvements and progress on current improvements will occur with the NASA Technical Monitor or other designated NASA personnel more frequently than quarterly.

- For agreed upon improvements, actual software, documentation and reports detailed above will be submitted to the NASA Technical Monitor at least 5% ahead of the agreed to schedule.

End R1 block addition

Begin R2 block addition

2.6 Sub-Task 6 - State of the Art Advancement in Cost Estimation

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

2.6.1 Deliverable: Debrief on the conference and/or short course.

2.6.2 Required date: As identified in conjunction with the Technical Monitor.

2.6.3 Performance Metrics:

Meets: Timely and thorough debriefing(s).

Exceeds: Innovative suggestions that combine/adapt new approaches.

End R2 block addition

Begin R4 block addition

2.7 Sub-Task 7 - Project Planning

The Contractor 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.

2.7.1 Deliverables and Schedule:

The Contractor shall deliver newly developed or updated project schedules and standard analytical reports according to the schedules approved by the appropriate Proposal Manager.

2.7.2 Performance Metrics:

The Contractor will warrant a "meets" rating if all schedules, reports 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.

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.

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 APPO will provide templates for required documentation. NASA will provide appropriate office space, telephone and Internet access, as required.

4. Other Essential Information:

Technical Experts will be required to travel to team meetings and review sites. [R3>]Also occasional foreign and incidental domestic travel are anticipated to perform other requirements of this task order.[<R3]

The Contractor and all Contractor personnel, including Technical Experts and Document Preparation Experts will be required to complete appropriate nondisclosure agreements.

[R1]Some overall increase in staffing is anticipated.

5. Security Clearance: None required

6. Period of Performance:

Planned start date: [R1]January 25, 2007 Completion date: [R2]~~December 31, 2007~~
[R3]~~December 31, 2008~~
[R4]~~September 30, 2009~~
September 30, 2010

7. NASA Task Management:

Technical Monitor (Required): [TD1>]**Kimberly A. Cannon**
M/S: 218 Phone: (757) 864-3814[<TD1]
Other POC (Optional): [R2]Beth Plentovich
M/S: 218 Phone: (757) 864-2857

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 002D2-NNL07AM03T Revision: 2 Change: 0 Date: April 4, 2008

Title: **Exploration Development Support**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 03D2C reduced to approx 1 WYE)

The Electronic Systems Branch has the responsibility to assist NASA Researchers with the validation of new technologies for NASA's Exploration vision. This task will provide support for data system integration to acquire flight test data that will be used to validate simulation and wind tunnel models.

Revision 1 (5/10/07): Extends the period of performance seven months to July 31, 2008 in continuation of NASA's support requirements, corrects the task order start date to January 25, 2007, and makes minor typo corrections overlooked previously (see R1 below).
Revision 2 (4/4/08): Extends the period of performance five months to December 31, 2008, in continuation of NASA's support and re-designates safety and organization subtask as 2.n with clarified requirements (see R2 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 Data System Integration:

1. The Contractor shall proved technical support for the Exploration Flight test Program. This support will include the generation of drawings, functional testing, integration testing and environmental testing of 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 shall be provided by the flight project.

3. The Contractor shall maintain configuration management for all drawings and hardware

2.1.1 Deliverables and Schedule (Required):

1. Configuration Control of all hardware and drawings as specified by the project
2. Drawings and test results
3. Ground Test Hardware

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

Meets:

1. Monthly written status reports.

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 6
TASK ORDER NUMBER: 003D3-NNL07AM04T Revision: 3 Change: 0 Date: September 1, 2009	
Title: **Advanced Nondestructive Evaluation and Health Monitoring of Aerospace Systems**	

1. Purpose, Objective, or Background (Optional) (This task transitions SAMS task 03RCF with possible incumbent staff retention of 5 WYE.) Research and technology development for advanced nondestructive evaluation and health monitoring sensors and intelligent systems to ensure structural integrity, configuration control, reliability, and safety for aerospace applications.

Revision 1 (8/27/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, re-designates safety and organization subtask as 2.n, adds requirements as new Subtask 2.6, and updates the initial task order start date to January 25, 2007 (see [R1] below)
Technical Direction 1 (10/4/07): clarifies safety and organization Subtask 2.n (see [TD1] below).
Revision 2 (9/22/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R2] below).
Revision 3 (9/1/09): Extends the period of performance 12 months to December 31, 2010 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 Contractor shall perform the task as detailed in subtasks below.

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. (See NOC designated item(s) and description below.) The Government will submit written work requests clarifying specifications of tests, software modules, and fabrications to be delivered by the Contractor. The types and numbers of these work requests are described in subtasks below. Daily interactions concerning work requests will be conducted with the work request initiators. In the performance of the work requests, the Contractor shall conduct appropriate routine equipment maintenance and calibration on the various systems used, and in some cases non-routine maintenance may be requested. The Contractor shall provide bi-weekly oral progress reviews of all ongoing requested work, to be presented to the task technical monitor, request initiators, and other NASA observers selected by the Task Monitor, at bi-weekly task technical reviews as scheduled by the Task Monitor. In addition, the Contractor shall provide monthly technical reports and monthly financial reports, both broken down to the subtask level, and other reports specified as deliverables in the individual subtasks, to the Task Technical Monitor.

2.1 **Subtask 1: Routine Laboratory Control Software Development (NOC)**

The Contractor shall, on a work request basis, develop software modules for laboratory instrument control, instrument reading, and database building, using commercial software applications and commercial software development tool applications (e.g. LabView, VBA, Excel, Access). Approximately 3 work requests will be submitted per calendar year

Deliverables for Subtask 1:

- Software modules integrated with NDE system components and mechanical subsystems
- Software module source code or databases as specified in work requests,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOC reviews.

Performance Standards for Subtask 1:

MEETS
- Written reports in response to requests
- Adherence to cost and schedules
- Quality and ease of use of software
- Meeting the software performance requirements specified in the written requests
- Ease of obtaining data information from Contractor's file structures

EXCEEDS
- Completes software tasks ahead of schedule
- Exceeding the software performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

2.2 Subtask 2: Mechanical Subsystem, Sample, and Fixture Design and Fabrication (NOC)

The Contractor shall, on a work request basis, design and fabricate NDE mechanical subsystems, test samples, specialized sample and detector holders, stands, lamp enclosures, and fixtures. The Contractor shall validate and integrate these subsystems and fixtures into advanced NDE measurement systems. When requested, the Contractor shall provide CAD drawings, and electronic files containing CAD designs, compatible with NASA automated shop fabrication tools. Approximately 40 work requests will be submitted per calendar year

Deliverables for Subtask 2:
- Validated Mechanical subsystems, integrated into NDE measurement systems, as specified in work requests,
- Test samples, holders, fixtures as specified in work requests,
- CAD files when specified in work requests,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOC reviews.

Performance Standards for Subtask 2:

MEETS:
- Written reports in response to requests,
- Adherence to cost and schedules,
- Quality and ease of use mechanical subsystems, fixtures, holders, and samples,
- Meeting subsystems integration and performance requirements specified in the written requests.

EXCEEDS:
- Completes work requests ahead of schedule
- Exceeding the integration and performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

2.3 Subtask 3: Electrical Fabrication and Integration of Advanced NDE System Components (NOC)

The Contractor shall, on a work request basis, fabricate electrical circuits and connections for interfacing and controlling mechanical subsystems, and instrument components of advanced NDE measurement systems. The Contractor shall configure NDE systems. The Contractor shall calibrate and validate these systems, and assess their performance capabilities. Approximately 4 work requests will be submitted per calendar year

Deliverables for Subtask 3:

- Validated electrical circuits for interfacing, driving, and controlling NDE subsystems and system components as specified in work requests,
- Assessment of integrated system performance,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOC reviews.

Performance Standards for Subtask 3:

MEETS:

- Written reports in response to requests,
- Adherence to cost and schedules,
- Integrated circuit performance meets specifications in the written requests.

EXCEEDS:

- Completes work requests ahead of schedule
- Exceeding the integration and performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

2.4 Subtask 4: Advanced Electronic Circuitry Fabrication (NOC)

The Contractor shall, on a work request basis, fabricate advanced electronic circuits for conditioning signals of advanced NDE instrumentation and systems. The circuits will be used to condition signals to enable improved processing capabilities and operating characteristics of advanced NDE systems. The Contractor shall perform the appropriate measurements required to determine the desirable operating characteristics of the circuits. The Contractor shall fabricate circuits that have the desired operating characteristics. The Contractor shall measure the operating characteristic of the circuit and determine deviations between actual and designed operating characteristics and report on effects of the deviations. The Contractor shall then test the circuit on the advanced NDE instrumentation and systems and validate its performance under operating conditions. Approximately 5 work requests will be submitted per calendar year

Deliverables for Subtask 4:

- Electronic circuits developed for conditioning signals of advanced NDE instrumentation and systems.
- Validated electronic circuits for conditioning of signals.
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOC reviews.

Performance Standards for Subtask 4:

MEETS:

- Adherence to plan
- Adherence to cost proposal
- Meeting the circuit performance requirements specified in the written requests
- Quality of reports meet NASA publication standards for informal reports.

EXCEEDS:

- Completes tasks ahead of schedule
- Exceeding the circuit performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

2.5 Subtask 5: Advanced NDE System Data Acquisition (NOC)

The Contractor shall, on a work request basis and as specified by the work requester, perform routine and advanced multi-disciplinary NDE measurements and analyses using NASA specified methodologies and with NASA developed data acquisition equipment and analysis software, in both the NDE laboratory and in in-situ settings. The Contractor shall insure currency of calibration status of measurement systems prior to data collection. As specified in the work requests, the Contractor shall employ NASA provided methodologies and NDE technologies and measurement systems including but not limited to:

- Advanced thermography systems for actively stimulated temperature histories for large field image scans and for fixed point and line scans (Approx. 2/month)
- Advanced Ultrasonic systems for Ultrasonic image scans and multi-point measurements (Approx. 6/month)
- Ultrasonic velocity, amplitude, and attenuation reduction (Approx. 6/month)
- Advanced lamb wave ultrasonic measurements (Approx. 2/month)
- X-ray micro-focus CT scan runs (Approx. 25/calendar year)
- Terahertz imaging scans (Approx 6/month)
- Real time radiography and full field CT scans (Approx. 4/month)
- Rotating electromagnetic probe measurements (Approx. 3/month)
- GMR-based self nulling probe measurements (Approx. 3/month)

Deliverables for Subtask 5:

- Archived raw and processed data (electronic and hardcopy),
- Informal written and oral reports of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOC reviews.

Performance Standards for Subtask 5:

MEETS:

- Written reports in response to requests:
- Completeness of reports (including archived raw and processed data, verification of system

configurations and methodologies, difficulties encountered, and quality of data).
- Adherence to cost and schedules,
- Quality of data

EXCEEDS:
- Completes tasks ahead of schedule
- 10% improvement in scheduled deliveries

Begin [R1] block addition

2.6 Subtask 6: Analysis of NDE Data (NOC)

The Contractor shall, on a work request basis, develop, test, implement and apply advanced data processing algorithms for extracting meaningful characteristics related to material and structural integrity from NDE data from a variety of NDE techniques such as, but not limited to thermography, x-ray computed tomography and eddy current. Analysis techniques shall range from image processing to enhance characterization of critical features in NDE images to developing algorithms for extraction meaningful information from data as acquired from NDE measurement systems. Approximately 12 work requests will be submitted per calendar year

Deliverables for Subtask 6:
- Algorithms for reduction of NDE data
- Results from application of algorithms to provide NDE data sets
- Software module source code or packages as specified in work requests,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOC reviews.

Performance Standards for Subtask 6:

MEETS
- Written reports in response to requests
- Adherence to cost and schedules
- Quality and ease of use of data reduction packages
- Meeting the algorithm performance requirements specified in the written requests

EXCEEDS
- Completes software tasks ahead of schedule
- Exceeding the algorithm performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

End [R1] block addition

2.n Subtask n: Working Environment Safety and Organization

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 specialized NDE systems, comprising portable data acquisition computers, data acquisition cards, manual scanners, motorized scanners, and sensors. The Government will provide parts, materials and components for approved mechanical or electrical modifications. The Government will provide parts, materials, and components for specimen mounting and preparation, and will provide access to the NESB NDE laboratories and machine shop as needed to complete task requirements. The government will provide software development tools and manuals required for completion of task requirements. The Government will establish appropriate memoranda of agreement with third party participants to enable full collaborative efforts.

4. Other Essential Information:

The Contractor shall conform to all Government, NASA LaRC, and other standard safety practices in all work areas at all time. Data generated in this task shall not be released to the public without prior written approval from the LaRC Task Technical Monitor. Some travel may be required depending on the requested (NOC) work

5. Security Clearance:

The task is unclassified, however, parts may be subject to Limited Exclusive Rights Data (LERD) restrictions.

6. Period of Performance:

Planned start date: R1 1/25/2007 Completion date: R1 ~~12/31/2007~~
R2 ~~12/31/2008~~
R3 ~~12/31/2009~~
12/31/2010

7. NASA Task Management:

Technical Monitor (Required): D. Michele Heath
M/S: 231 Phone: (757) 864-4964

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

TEAMS Task Order Performance Work Statement (PWS)	
TASK ORDER NUMBER: 008D3- NNL07AM06T Revision: 2 Change: 0 Date: September 11, 2008	
Title: R1 **Aerothermal Analysis for STS and PE Vehicles**	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 10RBH)

The NASA Langley Research Center Aerothermodynamics Branch (AB) provides experimental and computational data and analysis to define the aerothermodynamic performance of R1 Exploration and Planetary Entry (PE) vehicles across the speed range.

The general purpose of this task is to provide quick turn-around grid/flowfield analysis to meet aerothermodynamic analysis requirements of the AB across the speed range.

The expected outcome of this task is quick turn-around for aerodynamic and aeroheating analysis of parametric configuration changes for STS, R1 Exploration and PE vehicles.

Revision 1 (11/14/07): Extends the period of performance 12 months to December 31, 2008, in continuation of NASA's support, updates the initial task order start date to January 25, 2007, re-designates safety and organization subtask as 2.n with clarified requirements, and updates the title and other details (see R1 above and below).
Revision 2 (9/11/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see R2 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.

2.1 (NOC) Analyses and Analysis Enhancements:
The Contractor shall provide quick turn-around, across the speed range, aerodynamic and aeroheating analysis for STS, R1 Exploration and PE vehicles using the FELISA unstructured grid/flow solver and LAURA structured viscous flow solver software; modify/develop, evaluate, and implement software designed to enhance the analysis process.

2.1.1 Milestones (Optional):
TBD

2.1.2 Deliverables and Schedule:
Historically, on an annual basis, aerothermodynamic analyses of approximately 50 different configurations of X-Vehicle and Shuttle Orbiter class vehicles have been required. For each configuration, the grid generation required 2 to 3 days and an additional 3 to 4 days to obtain and post process the results. It is anticipated that new STS programs and new planetary initiatives will generate requirements similar in quantity and complexity, for aerodynamic screening and analysis.

The Contractor shall deliver in an informal written report for each analyzed configuration, the computed aerothermodynamics and comparisons with any experimental/computational data.

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

Standard: The Contractor shall complete the aerothermodynamic analysis of each configuration in less than 1 week after receiving the configuration geometry.

The above standard describes a minimum acceptable performance. To exceed minimum performance the Contractor can, for example:

1) Identify and implement procedures that produce a measurable decrease in human and/or computer resources required to do the aerothermodynamic analysis,
2) Create and implement software that produces a measurable decrease in human and/or computer resources required to do the aerothermodynamic analysis.

2.2 (NOC) Analysis Tools Development.

The Contractor shall assist in the development of flow field analysis and prediction tools for STS and PE entry vehicles including support for the LAURA and R1 ~~HEFSS~~ FUN3D solvers.

2.1.1 Milestones (Optional):

n/a

2.2.2 Deliverables and Schedule:

On an annual basis, this work is a quarter-time effort. It is scheduled around the aforementioned activities in section 2.1.

The Contractor shall deliver an informal written report documenting significant software modifications and additions.

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

Standard: The Contractor shall develop code that is modular, utilizes approaches for a massively parallel environment and build in basic commenting within modules to describe all input and output variables as well as a description of the algorithms.

The above standard describes a minimum acceptable performance. To exceed minimum performance the Contractor can implement changes that further improve the robustness of code modifications and additions, for example:

1) Develop regression tests for major sections of code which ensure that future changes to the code do not negatively impact the code itself
2) Implement unit tests for modules that are created or modified.

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:

The Government will provide the FELISA, GRIDEX, UNLATCH, LAURA and [R1] ~~HEFSS~~ FUN3D – including documentation and test cases - software as well as graphic workstation hardware for both grid generation and flow analysis. In addition, the Government will provide time on mainframe and cluster computers on an as needed basis, vehicle configuration geometries, and trajectory flowfield conditions.

4. Other Essential Information:

The Contractor should be aware that the AB does analysis for industry proprietary programs. All information concerning such programs must be handled with confidentiality and all deliverables are the sole property of the customer.

5. Security Clearance:

A secret level of security clearance is required for this task.

6. Period of Performance:

Planned start date: [R1] 1/25/2007 Completion date: [R1] ~~12/31/2007~~ [R2] ~~12/31/08~~ ***12/31/09***

7. NASA Task Management:

Technical Monitor (Required): Ron Merski
M/S: 408A Phone: 757-864-7539

Other POC (Optional): Mike DiFulvio
M/S: 408A Phone: 757-864-5229

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 004D3-NNL07AM07T Revision: 6 Change: 0 Date: 5-08-2009	
Title: **Characterization and Processing of Advanced Materials**	

1. Purpose, Objective, or Background (Optional) (This task is a follow-on to SAMS Task 19RCE.)

The purpose of this task is to develop processing technology and conduct mechanical testing and microstructural analyses 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 metallic materials for subsequent processing and/or analysis. The majority of materials to be processed include aluminum alloys, titanium alloys and intermetallics, nickel alloys and intermetallics, shape memory alloys, and continuous and discontinuous reinforced metal matrix composites. On a limited basis, polymeric and ceramic based material systems will be submitted for processing.

Revision 1 (4/11/07): Extends the period of performance twelve months to December 31, 2008 in continuation of NASA's support requirements with no changes in other detailed requirements, re-designates safety and organization subtask as 2.n, and corrects the task order start date to January 25, 2007 (see [R1], Section 6 below).
Revision 2 (01/14/08): Extends period of performance 18 months to June 30, 2009, in continuation of NASA's support requirements with no changes in other detailed requirements. Lockheed is enacting a subcontract with Colorado School of Mines in support of deliverables under NOC 07T-1019 that will have a period of performance of 15 months (through March 2009). This task extension will cover this subcontract period of performance plus an additional 3 months to give leeway for subcontract close-out activities. (See [R2] Section 6 below.)
Revision 3 (4/24/2008): Adds requirements as new Subtask 2.6, clarifies safety and organization Subtask 2.n, and clarifies due dates for final report in Subtasks 2.1 - 2.5 (see [R3] below).
Revision 4 (7/23/2008): Extends period of performance 6 months to December 31, 2009 and updates the Government estimate of quantities of processing runs, tests, and analyses. In addition, facilities listed in Section 3 are updated. (See [R4] below.)
Revision 5 (10/24/2008): Adds new processing requirement to Subtask 2.1; updated facilities listed in Section 3 (see [R5] below).
Revision 6 (5/8/2009): Extends period of performance 12 months to December 31, 2010 and updates the Government estimate of quantities of processing runs, tests, and analyses (see [R6] 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.

Overall Requirements:

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

Subtask 2.1: 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 [R6]***225*** batches of specimens).
- Mechanical Processing: Sheet specimens shall be subjected to cold and warm rolling (up to [R4]60 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 [R6]***90*** 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 [R6]***60*** consolidation runs).
- Alloy Synthesis: Novel and advanced alloys shall be produced using casting (up to [R4]120 runs) and ball milling (up to 30 runs).
- [R5>]Polymeric Material Synthesis and Processing: Assemble processing equipment hardware and tailor processing parameters to optimize fabricating and characterizing lab-scale quantities of polymers and polymer composites (up to [R6]***80*** batches)[<R5]
- 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 [R4]60 batches).

Deliverables (for 2.1):

- 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 NOCs, 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. (once at completion of task order)

Performance Standards (for 2.1):

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

Subtask 2.2 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 [R6]***1200***).
- Utilize TEM to assess the fine-scale microstructural features, chemistry, and phase content of specimens (up to [R6]***40***).
- Conduct bulk quantitative compositional analysis using methods such as atomic absorption, inductively coupled plasma analysis, and other wet-chemistry techniques (up to [R4]120).
- Utilize XRD to analyze bulk phase content, texture and residual stresses (up to [R4]300).
- Conduct material analyses using differential scanning calorimetry (DSC) and differential thermal analysis (DTA) to identify thermodynamic and kinetic events in metallic materials (up to [R4]60).
- 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 [R4]120).

Deliverables (for 2.2):

- 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. ([R3]once at completion of task orde***r***)

Performance Standards (for 2.2):

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

Subtask 2.3: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written request 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 [R6]***800***).
- Fracture toughness tests using J-integral analysis of R-curves generated from compact tension, center-crack tension, and other specimen configurations (up to [R4]80).
- Fatigue crack growth tests using compact tension specimens, center crack tension specimens, and other appropriate test specimen configurations (up to [R6]***80***).
- 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 2.3):

- For each NOCs, 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. ([R3]once at completion of task order)

Performance Standards (for 2.3):

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

Subtask 2.4: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written NOCs 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 [R6]***900***) 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 2.4):

- 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. ([R3]once at completion of task order)

Performance Standards (for 2.4):

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.

Subtask 2.5: 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 2.5):
- 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. ([R3]once at completion of task order)

Performance Standards (for 2.5):

MEETS
- CMTS data meets NASA standards
- MSDS catalog remains up-to-date

Begin [R3] block addition

Subtask 2.6: Advanced Microstructural Analysis for Structure-Property-Processing Correlation

The Contractor shall use advanced microstructural analysis techniques to correlate material processing history, mechanical properties, and microstructure. The Contractor shall identify modifications to processing routes to produce microstructures that will optimize the properties of the materials. The Contractor shall perform structure-property-processing correlation for the specific materials and processing technologies described below, which are the primary focus areas of this subtask. On a limited basis, the Contractor shall provide advanced microstructural analysis support for other materials issues that may arise (such as failure analysis, etc.):

(a) Electron Beam Free-Form Fabrication (EBF3) technology is being developed at LaRC for fabrication of near-net-shape and net-shape structures using aluminum, aluminum-lithium (Al-Li), titanium, and nickel alloys. The Contractor shall evaluate the microstructure of samples and parts fabricated with EBF3. The Contractor shall correlate the EBF3 processing parameters with the microstructure and mechanical properties of the various materials. The Contractor shall identify EBF3 process modifications or post-EBF3 processing routes to produce desirable microstructural features and optimize properties.

(b) Advanced aluminum and Al-Li alloys and specialized fabrication processes are being developed for manufacture of lightweight aerospace structures. The Contractor shall evaluate the microstructures of aluminum and Al-Li materials fabricated by traditional wrought processes and by near-net-shape fabrication methods. The Contractor shall correlate material chemistry, microstructure, and texture with material performance and with process variables. The Contractor shall identify modifications to fabrication and thermo-mechanical processes to optimize microstructure and processing.

(c) Sensory alloys are being developed at LaRC for use in aerospace vehicles using ferromagnetic shape memory material incorporated into structural alloys. These alloys exploit the shape memory transformation in response to deformation as a means to detect damage to aerospace structures in flight. The Contractor shall evaluate the microstructure and shape memory behavior of both candidate shape memory alloys and sensory alloys, and correlate these results with their chemistries and processing parameters. The Contractor shall identify chemistry and processing modifications for these materials to optimize their response.

Deliverables (for 2.6):

- *Informal written* monthly reports updating the status and results to date and any other pertinent issues
- Written informal final report discussing description of analyses and interpretation of results for correlation of microstructure with properties and processing (once at completion of task order).

Performance Standards (for 2.6):
MEETS:

- *Informal written* monthly reports updating the status and results to date and any other pertinent issues
- Adherence to ASTM or other relevant standards
- Written informal final report(s) discussing analyses and interpretation of results for correlation of microstructure with properties and processing.

EXCEEDS:

- *Formal written* report(s) published (NASA report, journal article, conference paper)

End [R3] block addition

Subtask 2.n: Working Environment Safety and Organization

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

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:

Materials processing equipment located in the Light Alloy Laboratory (Building 1205), the Materials Processing and Development Laboratory (Building 1267A), [R5>]and the Polymers and Composites Laboratory (Building 1293A) including the vacuum hot press, hot isostatic press, plasma spray apparatus, various ovens and furnaces, and polymeric materials processing equipment.[<R5] Materials processing equipment located in the Structures and Materials Laboratory (Building 1148) including superplastic forming facilities, resistance welding equipment, [R4>]and vacuum processing chambers.[R4]Surface preparation equipment located in Metals

Cleaning Laboratory (Building [R4>]1205 and 1267[<R4]) 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:

None.

5. Security Clearance:

None

6. Period of Performance:

Planned start date: [R1]1-25-2007

Completion date: [R1]~~12-31-2007~~
[R2]~~12-31-2008~~
[R4]~~6-30-2009~~
[R6]~~12-31-2009~~
12-31-2010

7. NASA Task Management:

Technical Monitor (Required): R. Keith Bird

M/S: 188A Phone: 43512

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 001AH-NNL07AM08T Revision: 5 Change: 0 Date: February 10, 2009	
Title: Independent Review of Agency Programs	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01AH)

The NASA Headquarters (Code D) Independent Program Assessment Office (IPAO) will conduct a series of Pre-Non Advocate Reviews (PNARs), Non Advocate Reviews (NARs), and Surveillance Reviews of Agency programs and projects. The Contractor will be expected to provide appropriate technical experts to supplement review teams conducting independent reviews of these programs. Although the volume and exact intensity of anticipated reviews for which support is required in the coming year cannot be accurately stated, the Contractor may draw from recent use history and anticipated usage as a planning basis and initiate changes with updated estimates as the actual requirements are more accurately determined through the NOC submissions (see note below in Section 2). The Contractor will be required to assist in performing technical and programmatic analysis focusing on one or more of the following areas of interest, appropriate to the particular program or project under review: Aerospace Vehicle Design; Propulsion; Power; Guidance, Navigation, and Control; Reliability, Maintainability, and Quality Assurance; Operations; Crew Systems; Safety and Mission Assurance; Risk Management; Project Management; Cost Estimating; and other associated disciplines. The Contractor will also be expected to provide appropriate management support to IPAO and to the Office of Program Analysis & Evaluation. [R3>]This support will include development of a Standard Operating Procedure (SOP).[<R3]

Revision 1 (4/20/07): Changes the IPAO Integrated Schedule delivery due date to monthly, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007 (see [R1] below).
Revision 2 (10/12/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R2] below).
Revision 3 (3/24/08): Adds urgent and compelling requirements as new subtask 2.5 and extends the period of performance 12 months to December 31, 2009 (see [R3] above and below).
Revision 4 (6/2/08): Adds and updates support requirements for subtask 2.5 to ensure FACA compliance for the SOP and the SRB Handbook (see [R4] below).
Revision 5 (2/10/09): Adds and updates documentation, OCI/PCI, editing, and meeting requirements and updates POC and GFI information (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) 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.

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

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

2.1.1 Deliverables and Schedule (Required):
The database as it is developed *within two business days of receipt of independent or NASA data*

2.1.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
MEETS if database is updated on schedule
EXCEEDS if updates delivered within one business day.

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

2.2.1 Deliverables and Schedule (Required):
Cost Reports *monthly (normally) and some ad hoc delivery may be required during surge activity*

2.2.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
MEETS if cost report is received on a monthly basis
EXCEEDS if cost report is received on a bi-weekly basis or as requested during surge activity.

2.3 (NOC) Technical and Programmatic Analysis: The Contractor's technical expert(s) shall provide results of technical and programmatic analysis for independent reviews of each required program or project, developing a detailed plan to perform the analysis and including schedules of the deliverable products. The primary product for each independent review shall be a final report summarizing the cost, schedule, and technical analyses conducted. The schedule for final reports and a schedule of meetings to be attended by the technical expert shall be developed by the technical expert in cooperation with the IPAO for each IA, IIR, or NAR undertaken.

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

2.3.1 Deliverables and Schedule (Required):
The technical expert(s) shall deliver the final report for each independent review *as specified in the individual NOCs.*

2.3.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Minimum acceptable performance:
Each final report shall be assessed for:
- Technical accuracy

- Findings must be clearly stated
- Alternative concepts must be clearly stated
- Recommendations must be clearly stated
- Overall assessment must be provided
- Executive summary

Exceeds minimum performance:

Each final report shall be assessed for:

- Findings to improve design and development process
- Propose alternative concepts that will benefit the government
- Recommendations for improving efficiency, capability, cost, and quality
- Executive summary identifying risks

2.4 Project Planning and Control: The Contractor shall maintain an integrated schedule to include all current and future IPAO reviews. The Contractor shall participate in and contribute to the IPAO weekly staff meetings. Specific activities include the following:

- The Contractor shall develop and maintain the IPAO Integrated Schedule with required resources identified for each activity.
- The Contractor shall use planning/scheduling software applications that provide for effective data entry, standard tabular reports, and graphics for data input.
- The Contractor shall track the review teams' progress to meet milestones and shall prepare analytical reports as requested.

2.4.1 Deliverables and Schedule (Required):

The primary product of project planning and control will be the updated IPAO Integrated Schedule. *The schedule shall be updated and delivered* R1~~*weekly*~~ monthly *prior to the IPAO staff meeting.*

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

Minimum acceptable performance: delivery of updated Integrated Schedule the day of but prior to staff meeting

Exceeds minimum performance: delivery of updated Integrated Schedule 24 hours or more prior to staff meeting

Begin R3 block addition

2.5 Development of Standard Operating Procedure: To be completed by R4~~October 30, 2008~~ December 30, 2009

Subtask POC: Tahani Amer M/S: 215 Phone/Fax Number: 4-5546/4-3927 E-mail Address: Tahani.r.amer@nasa.gov

R5>***The SOP, SOPI and other IPAO documents shall be completed according to specifications provided by the POC.***<R5

The Contractor shall develop an SOP for the operations of the IPAO. The primary purpose of this SOP is to guide IPAO employees on the specifics of performing agency-level reviews required by NPRs 7120.5 and 7123.1, and other documents. This SOP is also written to assist stakeholders outside IPAO in understanding the roles of IPAO employees and the full range of their responsibilities.

The Contractor shall perform the following requirements:

- The Contractor shall develop a standard operating procedure for program and project review for the Independent Program Assessment Office (IPAO), in coordination with TM. (see GFI Section)

- The Contractor shall provide the SOP that is designed based on the IPAO Program/Project Review Process- Level 1; include the five areas of the review.

- The Contractor shall provide a document control tree for the SOP.

- The Contractor shall develop all necessary flow diagrams, templates, and guidelines for the SOP.

- Development of the SOP shall include the following specific duties:

1) The Contractor shall review the IPAO Program/Project Review Process – Level 1, one-pager summary, dated March 4, 2008.
2) The Contractor shall review pertinent documentation prior to developing the story board and gap analysis for the SOP.
3) The Contractor shall develop flow diagrams, process diagrams, and any necessary graphics.
4) The Contractor shall participate in teleconferences.
5) SOP Package: The Contractor shall support the IPAO in the coordination of all processes, templates, procedure concerning the SOP development.

Begin R4 block addition

6) The Contractor shall update the SRB (standing review board) HB to comply with independency policy.
7) The Contractor shall develop new IPAO processes in support of the independency review such as, Risk Assessment, Integration of Cost and Schedule, SRB independency, and ICE and Schedule processes.
8) The Contractor shall synchronize the SOP with the NPR 7120.5D, SRB HB and FACA changes.
9) The Contractor shall perform technical editing in support of all the IPAO Documentations.

End R4 block addition

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

10) The Contractor shall update and develop documents selected by the POC to support the IPAO.
11) The Contractor shall provide continuous support to the IPAO on a part time basis as driven by day-to-day IPAO requirements.
12) The Contractor shall provide technical editing support to the IPAO for reviews, reports, and briefings. Note: IPAO will provide training on the IPAO products.
13) All Contractors shall be vetted/cleared for OCI/PCI according to the policy provided separately by IPAO.
14) All Contractors shall sign and comply with NDAs.

*****End R5 block addition*****

2.5.1 Deliverables/Milestones and Schedule:

The ongoing *general deliverables* through October 30, 2008 shall include, but are not limited to the following:

1) IPAO Standard Operating Procedure
2) IPAO Key Processes, including the cost and schedule analysis processes
3) Interfaces Processes between the SRB programmatic authority, institution authority and Agency executive management
4) Roles and Responsibility of IPAO personnel and SRB members

5) IPAO Products list
6) IPAO Templates
7) IPAO Improvement List
8) Training Material of the SOP
R5>***9) Updated SOP,SOPI, SRB HB ,and other IPAO documents***<R5

In addition to the ongoing deliverables above, the Contractor shall provide the following *key deliverables*:

Begin R4 block update

Deliverable	Schedule	Format
SRB HB update	Three weeks after task award- Approx. July 24, 2008	MS Office program by E-mail or in person
SOP Processes update and development	Six weeks after task award – Approx. August 15, 2008	MS Office program by E-mail or in person
SOP Flowcharts	September 4, 2008	MS Office program by E-mail or in person
Sync R5***SOPIs, SOP***,SRB HB and 7120.5D	September 30, 2008 R5>***March 2009- December 2009***	MS Office program by E-mail or hand delivery
Technical Editing – R5>***2 days turn around***	~~July 1- Dec. 30, 2008~~ ***March 2009- December 2009***	***MS Office program by E-mail or in person***<R5

Current Estimated *Milestones*:

Description	Location	Date
Task Status Meeting	NASA Langley	July 23, 2008
Task Status Review	NASA Langley	August 26, 2008
Task Status Review	NASA Langley	September 30, 2008
Completion of the Task	Telecon	December 30, 2008
R5>***Task Status Meetings/ Bi Monthly***	***NASA Langley***	***March 31, 2009 – Dec. 2009***<R5

End R4 block update

2.5.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Minimum acceptable performance: All deliverables are timely, clearly written, and with only minor corrections required.
Exceeds minimum performance: Meets minimum acceptable performance and at least half the

deliverables are three days ahead of schedule with no corrections required.

End [R3] 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 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: The IPAO will be responsible for augmenting task order funding to cover any work related travel required of the Contractor. All travel arrangements will be the responsibility of the Contractor.

Begin [R3] block addition for Subtask 2.5

The IPAO will provide the following documentation:

i. NPD 1001. 0, NASA 2006 Strategic Plan
ii. [R5>]***NPD 1000.5, NASA Acquisition Plan***[<R5]
iii. NPR 7120.5d, NASA Program and Project Management Process and Requirements
iv. NPR 7123.1, NASA Systems Engineering Process and Requirements
v. IPAO P-1000, IPAO Management Plan
vi. SRB Handbook
vii. PIR Guidance
viii. OMIs

End [R3] block addition for Subtask 2.5

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

ix. Review Reports
x. Review Briefings

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

4. Other Essential Information:

Begin [R3] block addition for Subtask 2.5

1) The Contractor shall plan for the following estimated travel: four, one-day meetings at NASA Langley.
2) Non-Disclosure Agreements: All proposed staff shall have a signed non-disclosure agreement.
3) The Contractor shall be capable of sending and receiving electronic media and shall maintain compatibility with the standard Microsoft Office suite of software and Acrobat (PDF) files.
4) The Contractor shall work closely with the IPAO POC, Ms. Tahani Amer, in the preparation, performance and reporting for the SOP.
5) Core Disciplines: Independent Review Expert w/procedure writing skills and Technical Editing

End R3 block addition for Subtask 2.5

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements.

6. Period of Performance:

Planned start date:	R1 January 25, 2007	Completion date:	R2 ~~December 31, 2007~~ R3 ~~December 31, 200~~8 December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): L. Renee Williams
M/S: 215 Phone: 757-864-2223

Other POC (Optional): R5> ***Tahani R. Amer***
M/S: 215 Phone: 757-864-***5546***<R5

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 001D2 Revision: 0 Change: 0 Date: February 5, 2007	
Title: Heat Shield Pressure Tube Lag Optimization for Mars Atmospheric Entry	

1. Purpose, Objective, or Background (Optional)

The Mars Science Laboratory Entry, Descent and Landing Instrumentation (MEDLI) project is to incorporate an atmospheric data system into the Mars Science Laboratory (MSL) heatshield, for collecting valuable environmental data during the spacecraft's entry into the Martian atmosphere. The data system includes a series of pressure ports, through the thermal protection system, which feed to pressure transducers mounted inside the aeroshell. The MSL (including MEDLI) is scheduled for launch in 2009. The project is on a very aggressive schedule, and an early determination of the proper port configuration is critical to successful integration with the MSL schedule. A matrix of arcjet tests have been scheduled to determine the port diameter that can be sustained under pyrolysis and ablation, providing a good pressure measurement without compromising heatshield integrity. Expected conditions at the pressure port locations range between 60 and 110 W/cm2 in heat rate, and 0.1 to 0.3 atmospheres in pressure.

In addition to determining the pressure port diameter, it is critical to compute time and pressure lag at pressure transducer locations to optimize the tubing configuration. The pressure lag and time lag depends primarily upon diameter and length of the ports.

The main objectives of this task are to optimize time and pressure lag based upon diameter and length of tubing.

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

- Develop a library of tubing response models
  - Calculation of pressure and time lag due to sinusoidal pressure change.
  - Calculation of pressure and time lag due to a continuous pressure ramp.
  - Calculation of pressure and time lag due to a pressure step.
  - Calculation of pressure and time lag due to a terminal pressure ramp.

- Develop a library of tubing response models for single tube with T branches.
- Develop a tubing response model for temperature gradients.
- Develop tubing response model for loops or bends in the tube.

2.1 (Requirement/subtask number one):

Subtask 1: Development of Tube Response Model Library using following matrix parameters.

The Contractor, working in conjunction with NASA pressure sensor development team members, shall develop a library of tubing response models (pressure and time lag) with the following matrix.

Tube diameters are: 0.04 inches, 0.07 inches, 0.1 inches, 0.2 inches
Length of the tubes are: 0.9 inches, 12 inches, and 0.5 inches
Internal Volume of the tubing connectors are: 0, 0, and 0.005 in^3

Subtask 2:

The Contractor, working in conjunction with NASA pressure sensor development team members, shall develop a library of tubing response models (pressure and time lag) for input pressures applied in the form of a sinusoidal, ramp, step, and terminal ramp. Additional specifications are given as follows:

- Calculation of pressure and time lag because of sinusoidal wave at 0.1 inch diameter and 12 inches long tube.
- Calculation of pressure and time lag because of ramp at 0.1 inch diameter and 12 inches long tube.
- Calculation of pressure and time lag because of step at 0.1 inch diameter and 12 inches long tube.
- Calculation of pressure and time lag because of terminal ramp at 0.1 inch diameter and 12 inches long tube.

Subtask 3:

The Contractor, working in conjunction with NASA pressure sensor development team members, shall develop a library of tubing response models (pressure and time lag) for tubing configurations in the form of a single tube with T branches. The model library shall be established in such a form that number of branches can be varied from two to six branches.

Subtask 4:

The Contractor, working in conjunction with NASA pressure sensor development team members, shall develop a library of tubing response models (pressure and time lag) for the presence of a temperature gradient in a 12 inches long tube. The model library shall be established in such a form that length and diameter of the tube can be varied in addition to temperature gradient.

Subtask 5:

The Contractor, working in conjunction with NASA pressure sensor development team members, shall develop a library of tubing response models (pressure and time lag) for the presence of a loop or a bend in a 24 inches long tube.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Item	Description	Delivery Date
1.	Report containing the following documentation: Complete response model library with matrix given in subtask 1	45 days from effective date of Task Order
2	Provide complete report with tubing response model library for input pressures applied in the form of a sinusoidal, ramp, step, and terminal ramp.	60 days from effective date of Task Order

TASK ORDER NUMBER: 001D2 Revision: 0 Change: 0 Date: February 5, 2007

Title: Heat Shield Pressure Tube Lag Optimization for Mars Atmospheric Entry

3.	Detailed Report on tubing response model for tubing configurations in the form of a single tube with T branches (max. six branches).	90 days from effective date of Task Order
4.	Report containing the model library when there is temperature gradient in 12 inches long tube.	120 days from effective date of Task Order
5.	Detailed report on tube response model for the presence of a loop or a bend in 24 inches long tube.	180 days from effective date of Task Order
6.	The Contractor shall provide a Final Report that documents and summarizes all work performed under this task. It shall include key results from the tube response model library with matrix and conditions provided in subtask 1, 2, 3, 4, and 5.	210 days from effective date of Task Order

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

Meets: Timely delivery of all deliverables as specified.

Exceeds: (Either of the following)

a. Meets with 10% early delivery of each deliverable

b. Meets with value added, innovative treatment on each deliverable

2.2 (Requirement/subtask number two):

…

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 (1%).

Meets: No repeated findings or incidents in six-month award fee period (1%).

3. Government Furnished Items: : LaRC pressure calibration test facilities in building 1230, R-211.

4. Other Essential Information:

5. Security Clearance: N/A

6. Period of Performance:

Planned start date:	February 14, 2007	Completion date: December 15, 2007

7. NASA Task Management:

Technical Monitor (Required): Qamar A. Shams
M/S: 238 Phone: 757-864-8156

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

TASK ORDER NUMBER: 007D2-NNL07AM10T Revision: 2 Change: 0 Date: November 29, 2007

Title: [R2]*ARES I-X Engineering Support*

1. Purpose, Objective, or Background (Optional)

[R2]***ARES I-X*** is a full-scale representation of the ARES I rocket and the associated Orion capsule system which will go into use when the Space Shuttle is retired. A modified Solid Rocket Booster (SRB) will serve as the first stage and propel the rocket. [R2]***ARES I-X*** will not have a functioning upper stage (i.e., the 2nd stage of the [R2]***ARES I-X*** will be a non-functioning mock-up), and, accordingly, the flight will be sub-orbital.

Langley Research Center (LaRC) is the home of the [R2>]***Ares I-X Crew Module/Launch Abort System (CM/LAS) Integrated Product Team (IPT), which is responsible for the design, analysis, and fabrication of the Crew Module (CM) and its attached Launch Abort System (LAS) hardware for Ares I-X.***[<2] The CM/LAS consists of the full-scale hardware comprised of the CM, which is a representation of the Orion capsule, and the attached LAS, which is the attached rocket-powered structure which would pull the actual CM to safety in event of a launch emergency. Both the CM and the LAS are essentially full-scale mock-ups, in that the capsule is not intended for a crew to use and is not populated or instrumented for actual orbit, and the rockets in the LAS are non-functioning. The CM/LAS, which is approximately 55 feet tall, 16.5 feet in diameter, and weighs over [R2]***16,000*** pounds, will be the upper portion of [R2]***Ares I-X*** when it is launched.

Revision 1 (3/13/07): Redefines Subtask 2 requirements and adds requirements as new Subtasks 3 and 4. This revision requires urgent and expeditious treatment. (see [R1] below)

Revision 2 (11/29/07): Extends the period of performance 15.5 months to April 15, 2009 in continuation of NASA's support; updates, clarifies, and adds various details including due dates and task order title; clarifies safety and organization Subtask 2.n; and adds requirements as new Subtask 5 (see [R1] above and below).

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Deleted: 3

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

2.1. CM/LAS Ground Support Equipment (GSE) Development and Design (Subtask 1):

2.1.1. The Contractor shall attend [R2]*ARES I-X* GSE working group teleconferences in support of the GSE planning, development and design. GSE includes handling, shipping, lifting, and test support hardware as well as fabrication fixtures.

2.1.1.1. The Contractor shall define requirements necessary for the development of the [R2]***ARES I-X*** GSE. The development of requirements will be an inter-center effort supported by government and contractor personnel.

2.1.1.2. The Contractor shall provide a comprehensive list of GSE that LaRC is responsible to build or purchase. The content of list will be developed by the [R2]***ARES I-X*** GSE working group. The Contractor shall book keep the list.

2.1.2. The Contractor shall design [R2]*ARES I-X* GSE.

2.1.2.1. The Contractor shall provide concepts for GSE. Concepts may be sketched or produced in CAD. Sketches shall be created to support the working group activities and initiate designs.

2.1.2.2. The Contractor shall design GSE hardware. All designs shall be created in Pro/Engineer and Maintained in [R2>]***PDMLink on the CAEDM-SRV3***[<R2] server.

2.1.2.2.1. The Contractor shall generate detail drawing for GSE designs.

2.1.3. Interfaces and Communication

2.1.3.1. The Contractor shall interface with the [R2]***ARES I-X*** designers to define interfaces to the CM/LAS hardware.

2.1.3.2. The Contractor shall interface with [R2]***ARES I-X*** operations personnel to define and capture functional requirements of GSE hardware.

2.1.3.3. The Contractor shall provide analysts with design information required to structurally analyze the GSE hardware. The Contractor shall consult with R1 analyst to optimize the structural design of GSE hardware.

2.1.4. The Contractor shall support R2 *ARES I-X* Reviews

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

2.1.5. The Contractor shall support fabrication efforts

2.1.5.1. When required, fabrication liaison shall be provided

*****Begin R2 block addition*****

2.1.6. The Contractor shall support assembly and integration efforts at Kennedy Space Center (KSC)

2.1.6.1. A total of three trips to KSC will be required with durations of 1 week, 1 week, and 2 weeks.

2.1.6.2. Once deliverable 2.1.7.5 is met, an additional four weeks of support is required to accomplish deliverable 2.1.7.6. The support includes the two weeks of travel to KSC for the assembly and integration as well as two (qty 2) one week technical interface meeting (held at LaRC).

*****End R2 block addition*****

2.1.7. Deliverables

2.1.7.1. List of required GSE

2.1.7.1.1. Preliminary due April 13, 2007

2.1.7.1.2. Final Due May 11, 2007

2.1.7.2. Design of required GSE

2.1.7.2.1. Conceptual due April 20, 2007

2.1.7.2.2. Preliminary due June 1, 2007

2.1.7.2.3. Final due R2 ~~July 20, 2007~~ ***June 30, 2008***

2.1.7.3. Drawings of required GSE

2.1.7.3.1. R2> ***Release to fabrication begins*** <R2 on September 7, 2007

2.1.7.3.2. R2 ***Release to fabrication ends on August 1, 2008***

2.1.7.4. Fabrication Liaison

2.1.7.4.1. Due date: ongoing

2.1.7.5. Update drawings to reflect as built condition

2.1.7.5.1. Due R2 ~~December 31,2007~~ ***December 31, 2008***

*****Begin R2 block addition*****

2.1.7.6. Assembly and Integration support at Kennedy Space Center

2.1.7.6.1. Due April 15, 2009

*****End R2 block addition*****

2.1.8. 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

Begin R1 block redefinition

2.2. <u>Instrumentation and Logistics Development and Design (Subtask 2)</u>

2.2.1. The Contractor shall attend various R2 *ARES I-X* working group teleconferences and meetings in support of Instrumentation and Logistics development.

2.2.2. The Contractor shall model instrumentation locations R2 *according to latest instrumentation*

location list.

2.2.3. The Contractor shall design instrumentation installation hardware. This includes items such as inserts for pressure transducers, machined cover plates for calorimeters and thermocouples, etc.

2.2.4. Create detailed fabrication and assembly drawings. All designs and drawings shall be created in Pro/Engineer and maintained in R2> *PDMLink on the CAEDM-S2SRV3* <R2 server.

2.2.5. Generate/update engineering documents to support reviews, analysis, reports, and trade studies

2.2.6. The Technical Monitor may provide non-supervisory guidance and clarification for the Contractor to perform other activities to further the design of the CM/LAS assembly. These activities include providing figures and presentations for various reviews, assisting other team members, hand analysis, and reviewing documents.

2.2.7. Deliverables

2.2.7.1. Final Design of CM

2.2.7.1.1. Due R2 ~~May 11, 2007~~ ***January 11, 2008***

2.2.7.2. Instrumentation installation hardware

2.2.7.2.1. Preliminary Design due April 20, 2007

2.2.7.2.2. Final Design due May 11, 2007

2.2.7.2.3. Detailed fabrication and assembly drawings due R2 ~~June 15, 2007~~ ***February 29, 2008***

2.2.7.3. Review Support

2.2.7.3.1. PDR due April 13, 2007

2.2.7.3.2. CDR due R2 ~~August 31, 2007~~ ***January 2008 and February 2008***

2.2.7.4. Update Drawings to reflect as built configuration

2.2.7.4.1. Due R2 ~~December 31, 2007~~ ***December 31, 2008***

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

End R1 block redefinition

Begin R1 block addition

2.3. Analysis of Launch Abort System (LAS) (Subtask 3)

2.3.1. Communicate with Ares Vehicle Integration Office to ensure analysis conforms to most current load case.

2.3.2. Create Finite Element Model of LAS.

2.3.3. Structural analysis of the LAS. This includes the entire structure as well as items such as interface flanges, bolt patterns, etc.

2.3.4. Combine with CM and perform a dynamic analysis of the entire assembly.

2.3.5. Generate/update engineering documents to support reviews, design, reports, and trade studies

2.3.6. Prepare a Structural Systems Report documenting the results of analysis

2.3.7. Deliverables

2.3.7.1. Finite Element Model and preliminary structural analysis due April 13, 2007

2.3.7.2. Review Support

2.3.7.2.1. PDR due April 13, 2007

~~2.3.7.2.2. CDR due August 31, 2007~~

2.3.7.3. First draft of LAS Structural Systems Report due R2 ~~August 31, 2007~~ ***May 1, 2007***

*****Begin R2 block deletion*****

2.3.7.4. ~~Second draft of LAS Structural Systems Report due September 28, 2007~~
2.3.7.5. ~~Dynamic Analysis of CM/LAS assembly due October 18, 2007~~
2.3.7.6. ~~Final analysis results and documentation due December 28, 2007~~

End R2 block deletion

2.3.8. 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

2.4. General Analysis (Subtask 4)

2.4.1. Primary effort will be to perform a structural analysis of ground handling equipment.

2.4.1.1. Items include lifting and handling fixtures, assembly fixtures, shipping fixtures, etc.
2.4.1.2. Generate/update engineering documents to support reviews, design, reports, and trade studies

2.4.2. Secondary efforts are listed as follows:

2.4.2.1. Communicate with Lead Analyst, LAS Analyst, CM Analyst, and Design Engineers to ensure that analysis conforms to most recent geometry and efforts are not overlapping.
2.4.2.2. Perform hand analysis on interfaces, bathtub fixtures, and R2***other*** hardware.
2.4.2.3. Assist other analysts in Finite Element Analysis of either CM or LAS
2.4.2.4. Assist in the preparation of documentation and review materials

2.4.3. Deliverables

2.4.3.1. Finite Element Model and preliminary structural analysis due May 21, 2007
2.4.3.2. Review Support
2.4.3.2.1. PDR due April 13, 2007 (if available)
2.4.3.2.2. CDR due R2~~August 31, 2007~~ ***January and February 2008***
2.4.3.3. First draft of GSE Structural R>2***Analysis completed December 28, 2007***<R2
2.4.3.4. Second draft of GSE Structural Systems Report due R2~~September 28, 2007~~ ***February 29, 2008***
2.4.3.5. Final analysis results and documentation due R2~~December 28, 2007~~ ***December 31, 2008***
2.4.3.6. Secondary efforts as directed

2.4.4. 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

End R1 block addition

Begin R2 block addition

2.5. LAS Design, Development, and Fabrication Support (Subtask 5)

2.5.1. Design and Development

2.5.1.1. The contractor shall design the LAS in a manner which minimizes schedule and cost while still surviving the given set of loads. To accomplish this, the designer must perform hand calculations for initial sizing of components and work closely with the LAS analyst who will be performing a more detailed analysis.
2.5.1.2. All designs shall be created in Pro/Engineer and maintained in PDMLink on the CAEDM-SRV3 server.

2.5.2. Fabrication

2.5.2.1. The contractor shall create detail fabrication, assembly, and integration drawings of the LAS and its components.
2.5.2.2. The contractor shall provide fabrication liaison during the manufacturing phase of the LAS.
2.5.2.3. The contractor shall revise all drawings to reflect the as built condition.

2.5.3. Deliverables

2.5.3.1. Final design of LAS due January 7, 2008
2.5.3.2. Detailed fabrication drawings due February 1, 2008
2.5.3.3. Assembly and Integration drawings due February 22, 2007
2.5.3.4. Fabrication liaison due date: ongoing

2.5.4. Performance Metrics/Standards – for the above listed deliverables, Meets Requirements will be defined as delivery by due date; Exceeds: No cited findings Requirements will be defined as delivery one week or reportable incidents in six-month award fee period.more prior to due date

*****End R2 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 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 provide office space equipped with phone and internet access.

4. Other Essential Information: N/A

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

6. Period of Performance:

Overall

Planned start date:	March 5, 2007 *	Completion date:	R2 ~~December 31, 2007~~ ***April 15, 2009***

Subtask 1

Planned start date:	March 5, 2007*	Completion date:	R2 ~~December 31, 2007~~ ***April 15, 2009***

Subtask 2

Planned start date:	March 5, 2007 *	Completion date:	R2 ~~December 31, 2007~~ ***December 31, 2008***

Subtask 3

Planned start date:	March 19, 2007*	Completion date:	R2 ~~December 31, 2007~~ ***May 1, 2007***

Subtask 4

TASK ORDER NUMBER: 007D2-NNL07AM10T Revision: 2 Change: 0 Date: November 29, 2007
Title: R2*ARES I-X Engineering Support*

Planned start date:	March 19, 2007*	Completion date:	R2~~December 31, 2007~~ ***December 31, 2008***

Begin R2 block addition

Subtask 5

Planned start date:	December 10, 2007	Completion date:	December 31, 2008

End R2 block addition

*Start dates may be earlier subject to Contractor staffing availability.

7. NASA Task Management:

Technical Monitor: Andrew Panetta

M/S: 432 Phone: (757) 864-1041

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 003D2 Revision: 1 Change: 0 Date: February 14, 2007

Title: **Magnetic Field Response Measurement Acquisition System Applications**

1. Purpose, Objective, or Background (Optional) (This work extends the SAMS task order 13RFL.) The primary work is support of Crew Launch Vehicle (CLV) Scaled Upper Stage Fuel Tank baffle design and testing. Specifically, a measurement system for measuring fluid motion (initially water) and then cryogenic fluid motion (liquid oxygen and liquid hydrogen) within the CLV upper stage fuel tanks using the measurement systems discussed in the references below. Secondary work is continued development of the magnetic field response measurement acquisition system and magnetic field response sensors. Background information of work related to 13RFL is discussed in detailed in the references below.

References

1 Woodard, S. E. and Taylor, B. D., Shams, Q. A. and Fox, R. L., "Magnetic Field Response Measurement Acquisition System," *NASA Technical Memorandum 2005-213518*, (2005).

2 Woodard, S. E. and B. D. Taylor, "A Wireless Fluid-Level Measurement Technique," *NASA Technical Memorandum 2006-19271*, (2006).

3. Woodard, S. E., Coffey, N. C., Gonzalez, G. A., Taylor, B. D., Brett, R. R., Woodman, K. L., Weathered, B. W. and Rollins, C. H., "Development and Flight Testing of an Adaptable Vehicle Health-Monitoring Architecture," NASA Technical Memorandum 2003-212139, January 2003

4. Taylor, B. D. and Woodard. S. E., "Wireless Fluid Level Measuring System," U. S. Patent and Trademark Office Application number 11/229,438.

5. Woodard, S. E. and Taylor, B. D. "System And Method For Wirelessly Determining Fluid Volume," Submitted to U. S. Patent and Trademark Office, LAR 17116-1.

6. Woodard. S. E. and Taylor, B. D., "Flexible Framework for Capacitive Sensing," U. S. Patent Number 7,047,807.

7. Woodard, S. E. and Taylor, B. D., "Magnetic Field Response Measurement Acquisition System," Submitted to U. S. Patent and Trademark Office, LAR-17280-1.

8. Woodard, S. E. and Taylor, B. D., "Magnetic Field Response Sensor for Conductive Media,". U. S. Patent Number 7,075,295,

9. Woodard, S. E., Coffey, N. C., Taylor, B. D., and Woodman, K. L., "Tributary Analysis Monitoring System," U. S. Patent Number 6, 879, 893.

Revision 1 (2/14/07): Adds requirements as new elements 2.10 and 2.11 (see [R1] below).

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

2.1. MFRR Antenna Electronics Control System

The Contractor shall develop an electronics control system:1. to provide a method of switching power to an oscillating antenna (previously developed and used for the MFRR); 2. to electrically short the antenna or provide high resistance to antenna circuit as a means of removing electrical current from antenna. The Contractor shall measure the antenna response after being switched with a short and then with the high resistance in the antenna circuit. The method that provides the quickest means of removing antenna magnetic (i.e., method that provides quickest magnetic field attenuation) shall be used in final design of circuit. The Contractor shall modify the two antennae magnetic field response recorder (MFRR) to use the switching electronics to facilitate higher magnetic field output.

2.1.1 Deliverables – Electronic Control System on a circuit board and drawings. The circuit board shall be sized to be added to existing MFRR circuit or placed in MFRR housing with existing circuit board and electronics.

2.1.2 Required date Feb 28, 2007

2.1.3 Performance Metrics

Exceeds: The Contractor delivers the Electronic Control System board and drawings one month ahead of schedule.

Meets: The Contractor delivers the circuit board and drawings on schedule.

2.2. MFRR Sequential Interrogation Control Program

The Contractor shall develop a control program for the MFRR to sequentially interrogate multiple sensors each having a frequency band (est. 0.5 - 1 MHZ bandwidth) that does not overlap with the other sensors.

2.2.1 Deliverable - Operating and verified program

2.2.2 Required date Mar 31, 2007

2.2.3 Performance Metrics:

Exceeds: The Contractor delivers the operating and verified program one month ahead of schedule.

Meets: The Contractor delivers the operating and verified program on schedule.

2.3. MFRR Enhanced Measurement and Display Capabilities

The Contractor shall add to the MFRR the following capabilities: 1. measurement and display output of sensor response damping factor information (this information corresponds to response bandwidth) as discussed in Ref 1 (Section 1); 2.Output display of frequency, amplitude and damping factor.

2.3.1 Deliverable - MFRR with added operating and verifiable capabilities.

2.3.2 Required date Mar 31, 2007.

2.3.3 Performance Metrics:

Exceeds: The Contractor delivers the MFRR with added operating and verifiable capabilities one month ahead of schedule.

Meets: The Contractor delivers the MFRR with added and verifiable capabilities on schedule.

2.4. Additional Frequency Synthesizer Codes

The Contractor shall add the frequency synthesizer codes responding to frequencies in 19-22 MHz corresponding to new sensor design.

2.4.1 Deliverable - File containing synthesizer codes referenced to respective frequency

2.4.2 Required date Mar 31, 2007

2.4.3. Performance Metrics:

Exceeds: The Contractor meets the deliverable one month ahead of schedule.

Meets: The Contractor meets the deliverables on schedule.

2.5. MFRR Calibration Control Program

The Contractor shall develop a control program for the MFRR to allow the user to provide calibration data to unit for one or more sensors using an external file via a personal computer interface such as a USB cable.

2.5.1 Deliverable - Operating and verifiable program.

2.5.2 Required date Feb 1, 2007

2.5.3 Performance Metrics:

Exceeds: The Contractor meets the deliverable one month ahead of schedule.

Meets: The Contractor meets the deliverables on schedule.

2.6. CLV Fluid Motion Testing

The Contractor shall assist the Principal Investigator (PI) in the CLV fluid motion testing.

2.6.1 Deliverable – Test Data as required by the PI. The PI will provide procedures and the required test data format.

2.6.2 Required date – As needed throughout the length of task period.

2.6.3 Performance Metrics:

Exceeds: The Contractor provides inputs to the Principal Investigator during test that results in the completion of testing one month ahead of schedule.

Meets: The Contractor assist the PI during the test and the test is completed within schedule.

2.7. Circuit Designs Drawings and Source Code

The Contractor shall provide the PI: 1. electronic and hard copies of all circuit designs drawings; 2. Source code in an electronic file

2.8.1 Deliverable - all circuit designs drawings (electronically and with hard copy), source code in electronic file

2.8.2 Required date – Throughout the duration of the task period as they become available and before December 31, 2008.

2.8.3 Performance Metrics:

Exceeds: The Contractor meets the deliverable one month ahead of schedule.

Meets: The Contractor meets the deliverables on schedule.

2.8. Monthly Reports

The Contractor shall provide a monthly report to the Task Monitor.

2.8.1 Deliverable: Monthly report

2.8.2 Required date: Last business day for the report period.

2.8.3 Performance Metrics:

Exceeds: Delivery on or before third to last business day for the report period.

Meets: All monthly reports were delivered on schedule.

2.9. Working Environment Safety and Organization

The Contractor shall maintain working environment of Rm 109, Bldg 1202 as safe and organized.

2.9.1 Deliverable: Prevention and correction of cited findings from NASA management

walkthroughs and reportable incidents.

2.9.2 Required date: Ongoing.

2.9.3 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.

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

2.10 Design and Fabrication of Crew Launch Vehicle Scaled-Tank Internal Iso-grid and Baffles

2.10.1 The Contractor shall develop CAD/Fabrication drawings for CLV fuel tank internal iso-grid to be fabricated using a stereo-lithography construction with polycarbonated plastic. Geometry for iso-grid section is shown in Fig 1. Tank dia is 15 in. Iso-grid should be able to be placed at different locations along length of tank

2.10.2 The Contractor shall develop CAD/Fabrication drawings for two (2) CLV fuel tank internal baffles and means (e.g., flange) of securing baffle to internal wall of tank. Baffles should be able to be placed at different locations along length of tank

Deliverables and Required Date(s):

a. CAD/fabrication drawings for CLV fuel tank internal iso-grid. March 31, 2007
b. CAD/fabrication drawings for two (2) CLV fuel tank internal baffles and means (e.g., flange) of securing the baffle to the internal wall of the tank. April 30, 2007

Performance Metrics:

Meets: Timely deliverables

Exceeds: Delivery one week ahead of schedule

2.11 Design and Fabrication of Support Equipment for Using Linear Actuator and Air Table for Producing Fluid Slosh

2.11.1 The Contractor shall develop a mechanical interface for coupling stroke from a linear actuator to the tank. Such means can also be used to support tank on air table for horizontal translation.

2.11.2 The Contractor shall develop mechanical interfaces to secure air table to structural base plates.

2.11.3 The Contractor shall develop mechanical support for tank having a bottom flat surface. Bottom surface will be placed on top surface of air table.

Deliverables and Required Date(s):

a. Development of a mechanical interface for coupling the stroke from a linear actuator to the tank. May 31, 2007
b. Development of mechanical interfaces to secure the air table to structural base plates. May 31, 2007
c. Development of mechanical a support for the tank having a bottom flat surface. May 31, 2007

d. Fabrication liaison support Through September 30, 2007

Performance Metrics:

Meets: Timely deliverables

Exceeds: Delivery one week ahead of schedule

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

3. Government Furnished Items: Laboratory in Rm 109, Bldg 1202 and test equipment in laboratory can be used in performance of task.

Other facilities as NASA Langley will be used as needed.

4. Other Essential Information:

1. Repair of Government furnished items may be scheduled through NASA-funded equipment repair facilities.
2. Contractor shall perform calibration on supporting instruments, such as meters, oscilloscopes, hot-bench instruments, etc., at less than or equal to 12-month intervals. Calibration of equipment may be scheduled through NASA-funded calibration facilities traceable to National Calibration Standards.
3. Contractor may use NASA environmental (Environmental Test Facility, Building 1250) and EMI test facilities to measurement systems.
4. Contractor may utilize NASA furnished parts and components.
5. Contractor may utilize NASA printed circuit fabrication facilities/resources to obtain printed circuit boards.
6. Contractor may utilize NASA furnished fabrication facilities/resources to complete fabrication, packaging and assembly of flight hardware, including mechanical hardware and wiring.
7. 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.

All documentation, drawings, software source code and hardware are to be treated as US Government NASA LaRC Property, except for those that are agreed upon by NASA LaRC Technology Transfer Office.

5. Security Clearance: None Required

6. Period of Performance:

Planned start date: January 2, 2007 Completion date: December 31, 2008

7. NASA Task Management:

Technical Monitor (Required): Mr. Guillermo A. Gonzalez

M/S: 398 Phone: 757-864-7107

Other POC (Optional): Dr. Stanley E. Woodard

M/S: 230 Phone: 757-864-4346

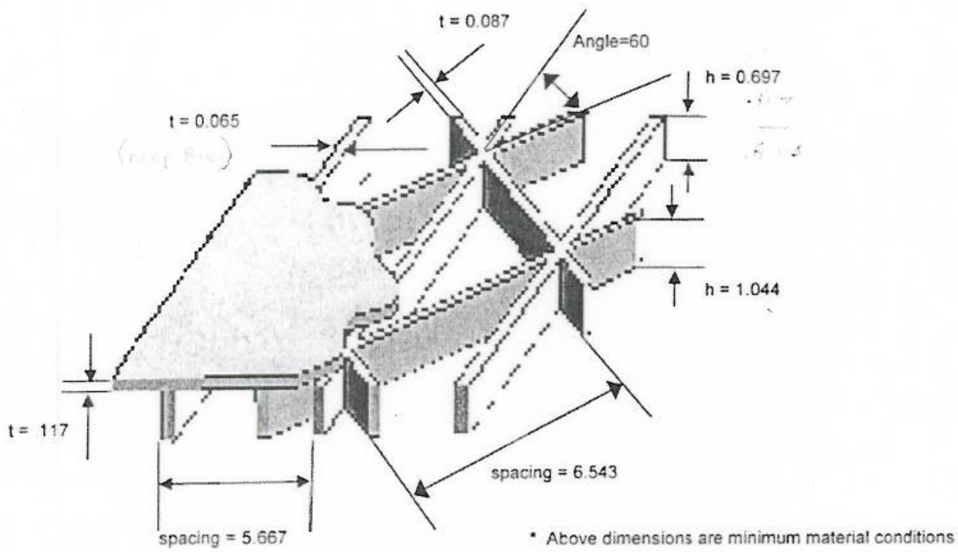

Fig. 1 Barrel section iso-grid

TEAMS Task Order Performance Work Statement (PWS)	**Page 1 of 1**
TASK ORDER NUMBER: 010D2-NNL07AM12T Revision: 1 Change: 0 Date: June 13, 2008	
Title: Development of Advanced Laser and Lidar	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 05D3G, Subtask 5 with completion date of January 18, 2007. We would like to transition and continuation of this task to TEAMS till September 30, 2008. We would also request the retention of the staff working under the SAMS contract.)

The purpose of this task is for the Contractor to conduct research for new materials and fabrication techniques for advanced thermoelectric (TE) device applications. Specifically, mid infrared solid state laser research and development and modeling, support for concurrent laser design projects in the Systems Engineering Directorate laboratories, and development and testing of lidar technologies and associated components and computer software will be conducted.
Revision 1 (6/13/08): Extends the period of performance 15 months to December 31, 2009 in continuation of NASA's support, clarifies Subtask 2.1 Schedule and Metrics, clarifies safety and organization Subtask 2.n, and updates the initial task order start date to January 25, 2007 (see R1 below).

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

2.1 Laser Research and Development: The Contractor shall perform mid-infrared solid state laser research and development. Tasks include but not limited to:

a. Theoretical calculations
b. Computer modeling and simulation
c. Laboratory experiments in the areas of:
   - Solid state laser oscillators
   - Solid state laser amplifiers
   - Pump laser diodes
   - Optics alignment and optimization
   - Performance characterization
d. Technologies development leading to space-qualifiable lasers by investigating the areas of:
   - Material out gassing and contamination
   - Radiation damage
   - Vibration resistance
   - Vacuum operation.

2.1.2 Deliverables and Schedule (Required):
Deliverables: Monthly and Final Reports
Schedule: As R1>***prescribed by the contract documentation requirements***<R1

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Metrics: Reports accurately and completely descriptive of work performed
Standards: (meets, exceeds):
Meets – R1>***Timely, accurate, and complete***
Exceeds – Meets plus value added in discussion of
a) significant findings or
b) innovative computational, modeling, and/or experimental techniques<R1

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:

Research shall be conducted on site at NASA LaRC throughout the period of performance. The Government will provide the following base support: Government-controlled working space, material and equipment. The Government will furnish or make available to the Contractor any documentation deemed necessary by the Government to accomplish this task.

4. Other Essential Information:

5. Security Clearance:

A DD 254 is not required for this requirement.

6. Period of Performance:

Planned start date: R1 ***January 25, 2007*** Completion date: R1 ~~September 30, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Dr. Jirong Yu
M/S: 468 Phone: 757-864-1766

Other POC (Optional): Dr. Upendra N. Singh
M/S: 468 Phone: 757-864-1570

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 005D2-NNL07AM13T Revision: 1 Change: 0 Date: December 11, 2007

Title: **Analytical Laboratory Investigations**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 10RFQ)

The purpose of the proposed task is to conduct analytical investigations in conjunction with a variety of projects that are being conducted by or have submitted samples to the NASA LaRC Facilities Engineering Laboratory for analysis and/or evaluation. Typical studies will attempt to identify or to measure specific properties of these samples that come from wind tunnel operations, material and structures research and environment requirements.
Revision 1 (12/11/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n with clarified requirements (see R1 below).

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

2.1 Analysis and Evaluation:
NASA will submit approximately 100 samples per year to the Contractor for analysis or for evaluation. These samples are generally small aliquots of larger quantities or small contaminate deposits and can be in gas, liquid or solid form. The Contractor shall perform the analysis appropriate for the submitted sample using the furnished equipment listed and the laboratory facilities of the Facilities Engineering Laboratory. Types of analysis and requirements to be performed by the Contractor include ASTM testing of lubricants, gas chromatography, x-ray fluorescence, atomic emission spectroscopy using inductively coupled plasma (ICP), thermal analysis, scanning electron microscopy, Infrared and Ultraviolet spectroscopy, acid digestion for composite fiber volume, plasma ashing, production of microspheres for wind tunnel flow visualization and particle sizing. Other instrumental and wet chemical methods also may necessarily be employed to perform the required tasks. The Contractor shall be required to perform normal instrument maintenance and assure proper functioning using manufacturer's calibration procedures on those instruments listed with an asterisk. The Contractor shall maintain a laboratory notebook with the details, procedures and data from each analysis performed, an update chemicals and equipment inventory computer listing, a weekly hazardous materials storage and disposal logbook and also maintain a safe operating laboratory environment per LaRC laboratory and safety procedures and the equipment manufacturers procedures and instructions.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

The Contractor shall provide as deliverables:

a) The results of each analysis are to be immediately reported either verbally or a short written synopsis to the Facilities Engineering Laboratory manager, to be recorded in the laboratory notebook, to be synopsized in a written monthly report and the analysis data delivered to the submitting party

b) A laboratory notebook (Government furnished) containing daily entries of work performed, analysis data, submitting party and laboratory status. When full is a deliverable and another notebook will be furnished.

c) Updated maintenance of the computer listing of chemical and equipment inventory. Ongoing.

d) Informal monthly reports listing the tasks completed during the month and a final yearly report summarizing the tasks performed, submitting unit at LaRC and analysis results.

e) A logbook containing the weekly status of hazardous material storage and disposals.

Ongoing.

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

Analyses completed within five working days are considered to meet minimum requirements; analysis completed in less than five days are considered to exceed task requirements. The work performance by the Contractor will be judged by accuracy of the analysis, analysis response time and the operation and maintenance of the laboratory in a safe manner as per NASA Safety Office inspections. Since the Facilities Engineering Laboratory is involved in the development and use of new instrumental analysis techniques, Contractor submitted suggestions for instrument improvement that are accepted by NASA shall be considered as exceeding minimum performance levels as well as any Contractor implemented improvements in analysis efficiency or property determination.

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 the following laboratory equipment (Buildings 1208, 1294, 1293, and 1272) to perform this task:

*Thermo-Jarrell Ash Model Atomscan 25 ICP Spectrometer

Perkin-Elmer Model PE 1600 Infrared Spectrometer

*Varian Model 3600 Gas Chromatograph

Perkin-Elmer Model 1700 DTA

*Brinkmann Model 684 Karl-Fisher Coulometer

*Hach model DR/2000 Spectrometer

Hitachi Model S-510 Scanning Electron Microscope

*Olympus Model BH-2 Microscope and Image Analysis System

*CEM Model 205 Microwave Digestion System

*Shimedzu Model SALD-1100- Laser Diffraction Particle Size Analyzer

*Spectrace Model 6000 X-Ray Fluorescence Spectrometer

4. Other Essential Information:

No formal travel is expected to be needed for performance of the tasks; only occasional attendance at local workshops and demonstrations by commercial instrument manufactures.

TASK ORDER NUMBER: 005D2-NNL07AM13T Revision: 1 Change: 0 Date: December 11, 2007

Title: **Analytical Laboratory Investigations**

A yearly government provided physical examination is required for monitoring of health due to exposure to hazardous chemicals listed on NASA LaRC safety permit (Arsenic, Cadmium, Benzene, Formaldehyde, Chloroform and Methylene Chloride.)

5. Security Clearance: None.

6. Period of Performance:

Planned start date: R1 ***January 25, 2007*** Completion date: R1 ~~December 31, 2007~~ ***December 31, 2008***

7. NASA Task Management:

Technical Monitor (Required): Warren C. Kelliher
M/S: 416A Phone: 757-864-4172

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

TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 006D2-NNL07AM14T Revision: 2 Change: 0 Date: March 18, 2009

Title: High Power Laser Diode Technology

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 36RFJ)
Solid state laser diode arrays R2>***that serve as the optical pump source for solid state laser materials, which in turn lase in the 2 micron region are of interest for several advanced applications.***<R2 Such laser output is valuable in that it would enable space based lidar systems that would measure winds, as well as other atmospheric phenomena and constituents R2>***and enable the development of navigation systems.*** <R2 However, current technology and understanding of the long-term operation of these diodes is quite limited. It is the goal of this project to purchase/obtain high power laser diodes R2>~~at 792nm (or 808 nm for validation)~~<R2 from a number of vendors and test them for long-term reliability. In addition, the objective of this work is to advance the technology, reliability, and understanding of risk reduction for these high power laser diode arrays. This work includes development, documentation, and functional testing of diodes and related components using state of the art testing methods.
Revision 1 (6/14/07): Extends the period of performance 18 months to June 30, 2009 in continuation of NASA's support with the requirements scoped up for the new period of performance, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n (see R1 below).
Revision 2 (3/18/09): Extends the period of performance 12 months to June 30, 2010 in continuation of NASA's support with various clarifications and updates (see R2 above and below).

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

2.1 General Daily Laboratory Operation: The Contractor shall be responsible for selection of thermal testing methods and protocols, development and fabrication of test fixtures, evaluation/use of methods and protocols, and selection of test equipment. R2>***The test fixtures shall be designed, modified, and/or fabricated to allow for the investigation of diode design criteria such as thermal performance and the effects of accumulated hours of operation on the optical and electrical properties. Test fixture design may include the development of a thermal vacuum system.***<R2 The Contractor shall participate in test evaluation and data interpretation. R2>Multiple laser diode package designs shall be tested as appropriate to achieve improved thermal performace. <R2 The Contractor shall keep laboratory records in a way that documents protocols and formulations and any data developed along the way. The Contractor may be required to contribute to publishing the results of this research effort. Modifications to control programming (Labview, R2>***for example***<R2) shall be documented. The Contractor shall investigate improved methods for acquiring test data.

2.2: Specific Testing and Evaluation: The Contractor shall evaluate Laser diodes upon arrival. The Contractor shall prepare the diodes for extended lifetime testing. R2>~~R1>This testing shall include up to 32 laser diode arrays operating simultaneously in simulated space-based LIDAR applications. The conditions shall include the newly developed thermal vacuum system.<R1~~<R2At regular intervals, the Contractor shall remove the diodes from life testing and perform detailed characterization. Initial testing shall include PIVR2>~~/LIV~~ (power, current, voltage~~/ life, current voltage~~<R2) characteristic curves, temperature versus wavelength/efficiency curves and photo documentation of physical characteristics. Characterization may include thermal analysis and heat transfer efficiency that will allow for development of improved design, construction and/or cooling methods.

2.1.1 Deliverables and Schedule (Required):
Quarterly reports R2>***6/30/09, 9/30/09, 12/30/09, 3/30/010, 6/30/10***<R2

TASK ORDER NUMBER: 006D2-NNL07AM14T Revision: 2 Change: 0 Date: March 18, 2009

Title: High Power Laser Diode Technology

Initial operating data on all laser diodes delivered. *Ongoing*

Work is to be carried out in a fashion that conforms to the overall project schedule.

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

Meets:

a. Adheres to schedule.
b. Written reports are provided according to schedule above.
c. Overall assigned tasks are completed within budget allowed.
d. Specified testing is completed.

Exceeds:

a. Testing completed ahead of schedule.
b. Written reports are provided according to schedule above.
c. All assigned tasks are completed under budget.
d. Specified testing is completed and additional contributions are made to furtherance of scientific goals and objectives.

2.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 all specialized material and equipment to conduct the work.

4. Other Essential Information:

The Contractor may be required to participate in travel R2>***within the US to technical meetings***<R2 in support of this project. Need for travel will be evaluated as required and budget augmentations provided to cover cost as needed. R2>~~Tentatively, for planning purposes, it is anticipated that the Contractor may need to make as many as two trips to GSFC for a period of 4 days each.~~<R2

5. Security Clearance, ITAR, OCI, and Other Special Handling Issues (Required): None

6. Period of Performance:

Planned start date: R1January 25, 2007 Completion date: R1~~December 31, 2007~~ *R2*~~June 30, 2009~~

June 30, 2010

7. NASA Task Management:

Technical Monitor (Required): **Byron L. Meadows**
M/S: 468 Phone: 757-864-5168

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 001D3-NNL07AM15T Revision: 2 Change: 0	Date: August 20, 2008
Title: **Aircraft Noise Subjective Research Support**	

1. Purpose, Objective, or Background (Follow-on to SAMS task order 01RBF.)

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

Revision 1 (11/5/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n with clarified requirements (see [R1] below).
Revision 2 (8/20/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R2] below, Section 6).
Technical Direction 1 (2/27/09): Replaces the Technical Monitor (see [TD1] 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) to this task order. See NOC designated item(s) and description below.

2.1

The Contractor shall perform the following requirements:

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

Subtask 1. Interview and recruit potential subjects and maintain a pool of subjects for participation in experiments in which people rate the acceptability, annoyance or other characteristics of sounds. The pool of prospective test subjects shall be established and maintained in such a way as to meet the following requirements:

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

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

Subtask 2. (NOC applicable subtask) Deliver up to 12 subjects per day to the NASA Langley Research Center test site on two weeks prior notice of clarification (NOC). An average of 12 subjects per month will be required, although the requirements during some months may be greater or less than the average of 12 per month. No more than 60 subjects per month will be required. All transportation shall be coordinated and provided by the Contractor. The times for delivery to and pickup from the test site shall be met by the Contractor with an allowable tolerance of +20 minutes. Of the total number of subjects delivered per month, about half may be required to be previously unused in other experiments conducted at LaRC, depending on the nature of the particular experiment. Some subjects may be required for two days at a time and/or for subsequent testing during the year. The normal testing period will be between 8:00 a.m. and 5:00 p.m. The normal test site will be Building 1208 at the NASA Langley Research Center. Subjects generally will participate in experiments for periods up to four hours on any given day.

Details will be clarified by NASA in the NOC.

2.1.2 Deliverables and Schedule

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

Schedule: This task is on-going and will continue throughout the period of this work statement. Tests requiring subjects will be defined by NASA Langley Research Center on two weeks prior notice of clarification (NOC).

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

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

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

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: Audiometric booth and audiometer

4. Other Essential Information:

5. Security Clearance: All work will be unclassified.

6. Period of Performance:

Planned start date: [R1]Jan 25, 2007 Completion date: [R1]~~Dec 31 2007~~ [R2]~~Dec 31, 2008~~ ***Dec 31, 2009***

7. NASA Task Management:

[TD1]Technical Monitor: ***Alexandra Loubeau***

M/S: 463 Phone: 757-864-***2361***

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 002D3-NNL07AM16T Revision: 1 Change: 0	Date: September 20, 2007
Title: **Technical Exhibit Management**	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01D3 with 1 WYE through Sep '07)

This work primarily supports the ARMD Aeronautics Test Program (ATP), which includes facilities and personnel from Ames, Glenn, and Langley Research Centers in the execution of national and international exhibits for professional societies (AIAA, ATE), other agencies (DOD), and NASA Headquarters. This work may also support similar work for non-ATP related organizations at the three NASA Centers.

Revision 1 (3/2/07): Adds Primary Technical Monitor and requirement for small purchases; updates travel requirements (see [R1] below).

Revision 2 (9/20/07): Expands and clarifies small purchase requirements in Subtask 2.1, re-designates safety and organization subtask as 2.n and clarifies its requirements, and updates the initial task order start date to January 25, 2007 (see [R2] 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 exhibit specifications for the Contractor as the requirements become defined.

2.1 (Requirement/subtask number one):

The Contractor shall provide the following:

- Research and recommendations on exhibit hardware purchases and develop a concept for a new ATP exhibit booth that has more flexibility in size
- Maintenance and inventory of exhibit hardware in all project locations
- Oversight and detailed tracking of shipping and receiving for all project exhibits
- Liaison with and negotiation with exhibit venues for all projects, e.g. AIAA, ATE, DoD, NASA Headquarters, etc. [R1]Small purchases may be necessary to facilitate coordination. [R2]***Purchases may include miscellaneous "user awareness" items (mugs, pens, folders), shipping costs for exhibit venues and/or general ATP material distribution (CDs/folders), and/or other actual exhibit services .***
- Travel to and from exhibit venues at the expense of the office requiring the travel, to be determined in advance and funded accordingly
- Oversight and supervision of set up and tear down operations at all exhibit venues
- Recommendations for equipment for each project on an exhibit-by-exhibit basis
- Maintenance and inventory of equipment for each project
- Research and recommendations on costs by external vendors on an as needed basis
- Marketing materials recommendations and development assistance
- Tracking of new business leads related to trade show exhibits to measure the success of the marketing efforts
- Assistance with development of program awareness articles and press releases and manage user-awareness communications with potential facility users
- Coordinate input from ATP facility managers at ARC, GRC, and LaRC and develop a minimum of 2 ATP-related user-awareness brochures and integrate existing footage into 2 videos
- Conduct user-awareness training for exhibit booth staff to ensure maximum benefit from these events

Travel will be required per the following itinerary:

[R1]~~Known travel for FY 07 is January 07, Reno, NV for the AIAA Aerospace Sciences Meeting, 6 days hotel, M&IE per diem plus airfare and rental car; and April 07, Munich, Germany for the Aerospace Testing Expo, 6 days hotel, M&IE per diem plus airfare and rental car.~~ Travel for ATP's Quarterly Reviews may be necessary to present User Awareness activities.

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.

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 exhibit work meets government standards for exhibits and within schedule.

Exceeds Standard: All exhibit work meets government standards for exhibits and is 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 [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:

Lap top computer for travel assignments, LaRCnet account, exhibit hardware, exhibit supplies needed to accomplish stated requirements.

4. Other Essential Information:

5. Security Clearance:

6. Period of Performance:

Planned start date: [R2]***January 25, 2007*** Completion date: November 30, 2007

7. NASA Task Management:

Technical Monitor (Required): [R1]Dina S. Weiss (Primary)

M/S: 111 Phone: 864-5293

Technical Monitor (Required): Peter F. Jacobs [R1](Alternate)

M/S: 162 Phone: 864-2855

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 005D3-NNL07AM17T Revision: 4 Change: 0 Date: **9 July 2008**

Title: Simulation Programming Support for Advanced Concepts Vehicles

1 Purpose, Objective, or Background

1.1 General Description

Begin [R4] block addition

This task provides mathematical modeling in software for simulation and analysis of flight dynamics and control law development for advanced concept vehicles. The task provides for further development and improvement of the existing Simulink-based Simulation Architecture for Evaluating Controls for Aerospace Vehicles (SAREC-ASV), application of SAREC-ASV to advanced vehicles and for documentation and user support. An aspect of desired development is to generalize SAREC-ASV to support flight controls oriented simulation of ascent, descent, and landing on celestial bodies. A desired improvement is to increase the segregation of generic and vehicle specific components to the point where the generic components can be updated without interfering with a vehicle specific implementation. The task also supports two specific NASA programs, the Supersonic project in Fundamental Aeronautics and the Crew Exploration Vehicle (CEV) development in Exploration Systems. Both these projects use SAREC-ASV and related tools to some extent, hence the rationale for maintenance of SAREC-ASV. Both Supersonic Aero and CEV also require analysis and support apart from SAREC-ASV development. Supersonic Aero requires tool development and support for an aeroelastic wind-tunnel test. CEV requires Monte Carlo analysis executed via CEV-sanctioned simulation tools to support design trade studies.

End [R4] block addition

1.2 Revision History

- Revision 1 (6/6/07): Extends the period of performance three months to March 31, 2008 in continuation of NASA's support requirements, adds requirements with updated metrics for the new period of performance, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n (see [R1] below).
- Revision 2 (11/9/07): Extends the period of performance 9 months to December 31, 2008 in continuation of NASA's support with additional and clarified requirements (see [R2] below).
- Revision 3 (2/19/08): Adds/updates requirements, schedule, and metrics (see [R3] below)
- Revision 4 (7/9/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with added/updated requirements, schedule, metrics, and formatting (see [R4] above and below) Note: For historical details deleted for clarity and/or convenience see previous versions of this Performance Statement (PWS) located on the electronic task order system (ETOS) as "doc" files.

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

2.1 Subtasks

2.1.1 Subtask 1 – Software Tool Development for Mathematical Modeling of Advanced Concept Vehicle Models:

Enhancements and vehicle model application support shall be provided to further develop and improve the existing Simulink-based Simulation Architecture for Evaluating Controls for Aerospace Vehicles (SAREC-ASV). Some areas identified for enhancement include

- Identification and separation of generic capabilities from vehicle-specific capabilities.
- Refinement of a ground-reaction subsystem model placeholder.
- Support of efforts conducted by the LaRC Flight Simulation Laboratory shall be provided in the areas of Guidance, Navigation, and Control (GNC) simulation development and gravity modeling for a lunar lander and future investigations applicable to celestial landers.
- Appropriate responses to bug reports from government users of SAREC-ASV shall be provided as necessary.

2.1.2 Subtask 2 – Support for Supersonic Fundamental Aerodynamics:

Enhancements and vehicle model Support shall be provided to the Supersonic Fundamental Aero project in the development of a flexible semi-span supersonic test article (S4T) in the form of developing excitation waveform definitions and assisting in the setup, execution, and post-test analyses of the S4T wind tunnel experiment. Examples of this support include:

- Apply MATLAB-based TDT analyzer frequency response estimation tool and Controller Performance Evaluation (CPE) tool to existing Test-597 and Test-600 data.
- Incorporate (MATLAB czt) frequency response estimation method into TDT analyzer/CPE suitable for use with responses from multi-sine excitation.
- Incorporate GFI linear and state space subsystem models into a simulation that includes nonlinearities such as actuator saturation and rate limits.
- Develop control laws for Ride Quality (RQ) at pilot station, Flutter Suppression System (FSS) and Gust Load Alleviation (GLA).
- Provide definition of excitation signals for use in S4T 2009 wind tunnel test.
- Provide control room support during 2009 wind tunnel testing of S4T model, to include excitation signal generation and signal log sheet.
- Analysis and documentation of results of S4T planned 2009 wind tunnel test.

2.1.3 Subtask 3 - Support for Crew Exploration Vehicle (CEV) Guidance & Control:

Support shall be provided to the Crew Exploration Vehicle (CEV) GNC Vehicle Integration team in the simulation, analysis and documentation of control system development for trans-atmospheric flight of orbital vehicles. Of specific interest are the flight control and performance characteristics of the Launch Abort Vehicle in all phases of ascent abort and the CEV in the entry phase. Examples of this support include:

- ANTARES simulation support in preparation for the GNC SDR --- Oct 22, 2008
- ANTARES simulation support in preparation for the CEV PDR --- Nov 30, 2008
- ANTARES simulation support post CEV PDR --- Dec 31, 2009
- Attend LAS and AA meetings each week to stay up to date on changes to design vehicle --- Monday and Wednesday
- Weekly written progress reports --- due Tuesdays, COB

ANTARES simulation support typically consists of Monte Carlo analysis of baseline and alternate concept studies to support design trades and maturity assessment. Support such as documentation, checkcase investigations of experimental control laws, and parametric studies of various control and guidance schemes will be provided within a government-furnished simulation architecture. That architecture supports the Vision for Space Exploration effort in the development and analyses of advanced aerospace vehicle dynamic simulations.

2.1.4 Subtask 4 - Working Environment Safety and Organization

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

2.2 Deliverables and Schedule:

2.2.1 For all subtasks:

a) Status reports delivered electronically to Task Monitor (Monthly)
b) Attend technical meetings recommended by Task Monitor/Project Lead (Weekly)

2.2.2 For subtask 1:

a) Provide refinement for ground reaction model, trim capability and gravity effects as required by Task Monitor (ongoing)
b) Provide version control, implementation of models, controller updates and revised documentation (ongoing)

2.2.3 For subtask 2:

a) Provide control room support during 2009 wind tunnel testing of S4T model, to include excitation signal generation and signal log sheet (during test)
b) Provide definition of excitation signals for use in S4T 2009 wind tunnel test. (prior to test)
c) Incorporate frequency response estimation method into existing tools suitable for use with responses from multi-sine excitation. (prior to test)
d) Analysis and documentation of S4T test. (six months after test)

2.2.4 For subtask 3:

a) ANTARES simulation support and Monte Carlo analysis (ongoing)
b) Provide final NASA CR with documentation of NASA Launch Abort Simulation 'hybrid' controller (one month after review by NASA staff)
c) Weekly written progress reports to Project Lead (by close of business each Tuesday)

2.2.5 For subtask 4:

a) Prevention and correction of cited findings from NASA management walkthroughs and reportable incidents.

2.3 Performance Metrics/Standard

1. The Contractor will meet performance standards if all of the following metrics are met:
   - 1.1. Attends 80% of technical meetings recommended by Task Monitor.
   - 1.2. Responds appropriately to SAREC-ASV bug reports within five (5) business days (fixed or work-around identified).
   - 1.3. Provides inputs to weekly CEV GNC activity reports as required by CEV project lead. These are required from all team members.
   - 1.4. ANTARES Monte Carlo analyses for CEV LAS and Entry phases are executed and reported generally on time and of acceptable quality.
   - 1.5. Provides final draft NASA CR documenting NASA Launch Abort Simulation 'hybrid' controller one month after review thereof by government.
   - 1.6. Draft of analysis and documentation of support for S4T wind tunnel entry is completed six months after the conclusion of the wind tunnel test.
   - 1.7. Receiving no repeated findings or incident reports in six-month award fee period.

2. The Contractor will exceed performance standards if all of the following metrics are met:
   - 2.1. Attends more than 80% of technical meetings recommended by Task Monitor.
   - 2.2. ANTARES Monte Carlo analyses for CEV LAS and Entry phases are executed and reported consistently on time and of acceptable quality.
   - 2.3. Provides final draft NASA CR documenting NASA Launch Abort Simulation 'hybrid' controller within two weeks after review thereof by government (two weeks early).
   - 2.4. Draft of analysis and documentation of support for S4T wind tunnel entry is completed five months after the conclusion of the wind tunnel test (one month early).
   - 2.5. No cited findings or reportable incidents in six-month award fee period.

3. Government Furnished Items**:**

Access to government computer resources, including Matlab/Simulink, desktop computer, and CVS/SVN software repository.

4. Other Essential Information**:**

5. Security Clearance**:**

This task is unclassified. Adherence to restrictions and control on company proprietary data is required for parts of some subtasks.

6. Period of Performance**:**

Planned start date: R1 25 January 2007

Completion date: R1 ~~31 December 2007~~
R2 ~~31 March 2008~~
R4 ~~31 December 2008~~

31 December 2009

7. NASA Task Management:

Technical Monitor (Required): **E. Bruce Jackson**
M/S: 308 Phone: 747 864 4060

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 006D3-NNL07AM18T Revision: 1 Change: 0 Date: 6/25/08	
Title: **Wind Tunnel Support for Facility and Technique Upgrades and Testing**	

1. Purpose, Objective, or Background (Optional) (This support was previously obtained under SAMS task order 31RDA.)

The mission of the Flight Dynamics Branch (FDB) 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. Flight dynamics research is highly multidisciplinary and includes work in the fields of attached and separated-flow (non-linear and unsteady) aerodynamics, static and dynamic stability, control effector characteristics, dynamic modeling methods, flight-control-law effects, flying and handling qualities, agility and maneuverability, and out-of-control flight characteristics. This research is performed through the formulation, conduct, analysis, and correlation of a wide range of research methods including static and dynamic wind-tunnel tests, computational aerodynamics studies, dynamically-scaled model tests, analytical analyses, simulation studies, and flight tests.

Numerous [TD2]***simulation and*** wind tunnel test techniques are used as a part of this research, including static force and moment tests, pressure tests, power effects tests, tunnel flow surveys, flow visualization, wind-tunnel free-flight tests, and dynamic tests including forced oscillation, free-to-roll, dynamic pitch, free spin, rotary balance, and combined motion.

This task pertains to developing and improving facility capabilities that are used in wind tunnel testing by the Flight Dynamics Branch and in supporting preparation and conduct of these tests.
Technical Direction 1 (6/16/07): Corrects the task order start date to January 25, 2007 and the completion date to December 31, 2008 (see [TD1] below).
Revision 1 (6/25/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support, re-designates safety and organization subtask as 2.n with clarified requirements, documents the Technical Monitor change, provides descriptive titles for Subtasks 2.1 through 2.3, and adds requirements as new subtask 2.4 (see [R2] below).
Technical Direction 2 (1/7/09): Clarifies support to include simulation work (see [TD2] 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) s to this task order. As each specific support requirement becomes scheduled, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

2.1 [R1]***Subtask 1: Development and Coordination of Facility Upgrades and Modifications (NOC)***

This subtask concerns the development and coordination of facility upgrades and modifications to the wind tunnel test techniques and facilities used by the Flight Dynamics Branch. This support is needed on an intermittent basis. The expectation is that support will be needed for 3 to 4 minor upgrade/modifications per year (such as coordinating the implementation of an upgraded control computer for support system control), and approximately one moderate upgrade/modification per year (such as coordinating the implementation of an upgraded wind-tunnel drive Motor-Generator (MG) set). When notified, the Contractor shall provide the following engineering support for accomplishing an identified upgrade or modification:

1) Recommended requirements.
2) Recommended sources.

3) Coordinate the implementation of the upgrade or modification with the hardware and/or service providers selected by NASA.

2.1.1 Milestones (Optional): N/A

2.1.2 Deliverables and Schedule (Required):

1) Recommended requirements, due two weeks after notification.
2) Recommended sources, due two weeks after notification.
3) Coordination of the implementation, when notified.

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

Meets: Support is provided per the required schedule. Support contributes to the success of the upgrade or modification.

Exceeds: Support is provided ahead of schedule. Use of innovative methods results in project completion ahead of schedule or under budget.

2.2 [R1]***Subtask 2: Wind Tunnel Test Engineering*** [TD2>]***and Simulation***[<TD2] ***Support (NOC)***

The Contractor shall provide engineering [TD2]***and simulation*** support for approximately 4 wind tunnel tests per year to be conducted by FDB. Notification for services and the tunnel schedule will be provided to the Contractor at least two weeks in advance, using the best information available. The support shall include preparations for test entry and conduct of the tests [TD2>]***as well as simulation studies***[<TD2]. When notified, the Contractor shall support testing during two-shift operation.

2.2.1 Milestones (Optional): N/A

2.2.2 Deliverables and Schedule (Required):

1) Test [TD2]***and simulation*** support, beginning two weeks after notification and ending at the completion of the test.
2) Test [TD2]***and simulation*** notes, due at the completion of the test.
3) Run [TD2]***and simulation*** logs, due at the completion of the test.

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

Meets: Support is provided per the required schedule. Support contributes to the success of the test.

Exceeds: Support is provided ahead of schedule. Innovative methods, test techniques, or staffing results in improved test productivity.

2.3 [R1]***Subtask 3: Electronics and/or Instrumentation Support (NOC)***

When notified, the Contractor shall provide electronics and/or instrumentation support for wind tunnel testing conducted by FDB. This support is needed on an intermittent basis. The expectation is that support will be needed 3 to 4 times per year for minor tasks. Example tasks are designing and fabricating wiring to connect a new sensor package (rate gyro, accelerometer, etc.) to the existing data acquisition system, and designing and fabricating electronic shielding systems when unacceptable levels of electronic noise are encountered in specialized applications.

2.3.1 Milestones (Optional): N/A

2.3.2 Deliverables and Schedule (Required):

1) Electronic/instrumentation design, due two weeks after notification.
2) Electronic/instrumentation fabrication, due four weeks after request.

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

Meets: Support is provided per the required schedule. Support contributes to the success of the test.

Exceeds: Support is provided ahead of schedule. Innovative methods result in improved test productivity.

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

2.4 Subtask 4: Engineering Study of New Vertical Wind Tunnel (NOC)

The contractor shall provide an engineering study for a new vertical wind tunnel in the West Area of Langley Research Center. The tunnel would be a replacement for the 20-Foot Vertical Spin Tunnel and 12-Foot Low Speed Tunnel and should incorporate the variety of testing now conducted in both facilities. This support is needed on an intermittent basis. The expectation is that this subtask would not be required more than once per year. When notified, the Contractor shall provide the following engineering suggestions for accomplishing and identifying a new wind tunnel design:

1) Recommended requirements.
2) Recommended design.

2.4.1 Milestones (Optional): N/A

2.4.2 Deliverables and Schedule (Required):

1) Recommended requirements, six months after notification
2) Recommended design, six months after notification
3) Recommended cost estimates, nine months after notification

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

Meets: Study is provided per the required schedule and contributes to the success of the new wind tunnel.

Exceeds: Study is completed ahead of schedule and enhances the capability of the new wind tunnel through the use of innovative design concepts.

****End [R1] block addition*****

TASK ORDER NUMBER: 006D3-NNL07AM18T Revision: 1 Change: 0 Date: 6/25/08

Title: **Wind Tunnel Support for Facility and Technique Upgrades and Testing**

R1 2.n ***Subtask 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:

1. Task personnel will have access to the tunnel in which the test is being conducted.
2. Task personnel will have access to the NASA and/or other contractor engineering personnel and technicians involved in the test.
3. Task personnel will have access to the wind tunnel model(s) and associated instrumentation and data systems involved in the test.

4. Other Essential Information:

5. Security Clearance: A secret security clearance is required for some of the testing conducted under subtask 2.2. A security clearance is not required for subtasks 2.1, 2.3, and R1 ***2.4***.

6. Period of Performance:

Planned start date: TD1 January 25, 2007 Completion date: R1 ~~TD1 December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): R1 ***Charles M. Fremaux***

M/S: 308 Phone: 757-864-***1193***

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 009D3-NNL07AM19T Revision: 2 Change: 0 Date: December 11 ,2008

Title: **Engineering and Software Programming Support for the AirSTAR Facility**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 26RDC)

BACKGROUND

The focus of the Integrated Resilient Aircraft Control (IRAC) element under the Aviation Safety Program is to conduct research for developing aircraft flight control systems to prevent aircraft loss of control accidents. Loss of control accidents can occur as a result of aircraft control system failures (such as a stuck or hard-over control surface), significant external disturbances (wake vortex, windshear, etc.), discrete source damage, or icing conditions. Large pitch and roll aircraft attitudes normally proceed most loss of control accidents during which flight outside the normal flight envelope occurs; that is, flight trajectories with extremely large values of angle-of-attack and sideslip. Testing IRAC research systems outside the normal flight envelope on full-scale aircraft is infeasible due to the high level of risk. As a result of this, research facilities are being developed to test IRAC systems on subscale Remotely Piloted Vehicles (RPVs). In addition, research tools such as full-scale and subscale six degree-of-freedom (6DOF) non-linear aircraft simulations based on large angle-of-attack and sideslip wind tunnel data are being developed for designing, developing, and assessing the performance of IRAC research control systems.

The main facility for this research is the Airborne Subscale Transport Aircraft Research (AirSTAR) Testbed that is currently under development at the Langley Research Center (LaRC) and consists of two ground stations – the Base Research Station (BRS) and the Mobile Operations Station (MOS) – and subscale RPVs that will include subscale models of transport aircraft. Two RPVs have been built that are dimensionally scaled to 5.5% of a transport aircraft and are dynamically scaled as well. These RPVs have been named Generic Transport Model (GTM) aircraft and are dynamically scaled so that flight test data can be related more easily to full-scale transport aircraft. The ground stations provide the communications link with a RPV to control and receive sensor data from the RPV. The BRS is a stationary ground station and the MOS is essentially a BRS installed in a truck for deployments.

The BRS and MOS have a flight research station (where a research pilot and principal investigator/flight test engineer will be located), an operations engineering station (where a hardware engineer and software engineer will be located) and an operations command station (where a flight test director and researcher will be located). The BRS is used for IRAC research system development and checkout, and flight test operations training. The MOS will be used to conduct the flight tests of the IRAC research systems and outside-the-envelope aerodynamic experiments. During a research flight test, the MOS and one or more RPV aircraft will be located at a test site runway and the MOS will be able to communicate with the BRS via a satellite link, if desired. A flight test will be initiated with safety pilots, located near the runway, flying a RPV aircraft from the runway and then transferring control to a research pilot located within the MOS. The research pilot will fly the RPV to setup the test condition and then fly the test run or enable a stored set of surface commands to be sent to the RPV or enable autonomous control. When test runs are completed or the aircraft must land, the safety pilots can take control of and land the RPV aircraft.

The flight research station has displays, a side-stick controller, and throttle lever that allows the research pilot to fly the RPV aircraft. Real-time control software within the MOS will compute GTM control surface commands from either the researcher pilot side-stick and throttle inputs or automatic/autonomous research control laws and those will be sent to the RPV via an RF uplink. Sensor measurements on-board the RPV will be sent to the MOS via a RF downlink and processed by real-time software to drive the pilot, researcher, and system health-monitoring displays; to provide feedback signals for pilot and research control laws; and to record data for post flight playback and analysis.

Real-time code for the BRS and MOS will be executed within a dSpace® system. With this system, hardware-in-the-loop simulations for system checkout in preparation for flight tests can be conducted. Control law software, uplink/downlink signal processing software, and computed display parameters will be executed in the dSpace® system.

A Matlab® Simulink® non-linear 6DOF GTM simulation to represent the dynamically scaled GTM aircraft has been developed and will continue to be updated. The GTM simulation aerodynamic database is being developed from wind tunnel data gathered at both normal flight envelope and outside the normal flight envelope (e.g., large angle-of-attack and sideslip angles) conditions. The wind tunnel data was generated using a generic twin jet 5.5% transport scale model. Updates to the simulation aerodynamic database will occur as flight test data is gathered and analyzed.

The GTM simulation will be used in the BRS/MOS for system and IRAC research experiment software checkout. The simulation will also be used in the BRS/MOS and desktop simulations for pilot control law development and pilot training. For this use the simulation is designated as the GTM BRS/MOS Simulation. Research experiment algorithms implemented and developed in the Simulink® simulation will be implemented in dSpace® using Matlab® Real-Time Workshop®. Real-Time Workshop® automatically generates real-time code from Simulink® block diagrams.

The GTM simulation will also be used for IRAC research engineering studies and IRAC control system development. Options to configure the simulation for this use have been and continue to be developed. In this use, the simulation is designated as the GTM Engineering Simulation. The GTM Engineering Simulation provides a means for IRAC researchers to easily integrate IRAC control systems in the GTM simulation. The GTM Engineering simulation also provides a Graphical Users Interface (GUI) for trimming of the aircraft model, for generating linear models about the trim condition, and running the simulation according to GUI specified conditions.

GENERAL TASK DESCRIPTION

This task provides software engineering support for development R2>***and implementation of aircraft flight control laws in 6DOF simulation and hardware flight environment associated with the AirSTAR flight test facility.***<R2 Contractor must have expertise in both *C* and Matlab/Simulink® programming, including linking of externally coded modules and autocode generation for real-time systems. Task requirements are often provided in terms of aircraft parameters and system capabilities. The contractor must translate these requirements into software specifications. Therefore, knowledge in flight dynamics, cockpit displays, and aircraft instrumentation systems is also required.

Revision 1 (9/7/07): Adds requirements to Subtasks 2.1 and 2.2, updates deliverables, schedule, and metrics in Subtasks 2.1, 2.2 and 2.3, extends the period of performance 5 months to December 31, 2008, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007.
Technical Direction 1 (9/25/07): clarifies safety and organization Subtask 2.n (see TD1 below).
Revision 2 (12/11/08): Significantly de-scopes task, extends the period of performance 12 months to Dec.

31, 2009, and adds Alternate Technical Monitor (see [R2] above and 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)

*****Begin [R2] block descope*****

2.1 Subtask 1 – BRS/MOS Software:

– The Contractor shall develop software and data to aid in the development of flight control software.

– The Contractor shall aid developers in testing and debugging flight control law software.

– The Contractor shall maintain the flight control law software under version control using the Subversion software tool. Software that is used during a flight experiment shall be exported and archived along with any flight test data collected.

– The Contractor shall provide engineering support, as required by the implementer, for implementing the Simulink® signal processing and control law software into the dSpace® real-time system.

2.1.1 Deliverables and Schedule:

- Monthly technical reports that detail status of on going work and highlight any concerns with the schedule, budget, or technical feasibility.
- Software that meets the software requirements specified by the Government (GFI 3.5).
- Documentation showing the delivered software has been entered in Subversion software control.

2.1.2 Performance Metrics/Standard:

MEETS

- Monthly technical reports received within 3 weeks from the end of month's efforts.

EXCEEDS

- Monthly technical reports received within 2 weeks from the end of month's efforts

*****End [R2] block descope*****

2.n Subtask n Working Environment Safety and Organization:

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:

3.1 Access to LaRC computer network.
3.2 R2 ***One*** Matlab® and R2 ***One*** Simulink® software licenses.
3.3 Access to computer server with Subversion version control software installed.

4. Other Essential Information:

5. Security Clearance: None required

6. Period of Performance:

Planned start date: R1 Jan 25, 2007

Completion date: R1 ~~July 30, 2008~~
R2 ~~Dec 31, 2008~~
Dec 31, 2009

7. NASA Task Management:

Technical Monitor (Required): **Richard M. Hueschen**
M/S: 308 Phone: 757-864-4036
R2 **Alternate Technical Monitor:** ***Irene M. Gregory***
M/S: 308 Phone: 757-864-***4075***

TEAMS Task Order Performance Work Statement (PWS)	
TASK ORDER NUMBER: 010D3-NNL07AM20T Revision: 3 Change: 0 Date: February 24, 2009	
Title: **Electromagnetics Research**	

1. Purpose, Objective, or Background (Follow-on to SAMS task order 02RDI)
The purpose of this task is to identify electrical engineering and technical support required by the High Intensity Radiated Fields (HIRF) Laboratory [TD1]and related facilities for the conduct of Electromagnetic Interference/Electromagnetic Compatibility (EMI/EMC) Electromagnetics Research.

Technical Direction 1 (5/31/07): Fills in details to complete the general description of work by adding the words "and related facilities" and updates the initial task order start date to January 25, 2007 (see [TD1] above and below).
Revision 1 (7/11/07): Extends the period of performance one year to December 31, 2008 in continuation of NASA's support with updated and clarified requirements and re-designates safety and organization subtask as 2.n (see [R1] below).
Technical Direction 2 (9/21/07): Fills in and clarifies details that were omitted on equipment calibration management and clarifies safety and organization Subtask 2.n (see [TD2] below).
Revision 2 (7/1/08): Extends the period of performance one year to December 31, 2009; rescopes, updates, and clarifies requirements; and documents an earlier Technical Monitor change (For current updates and clarifications, see [R2] below.) Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files.
Revision 3 (2/24/09): Adds test and travel requirements (see [R3] 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.

Begin [R2] block rescope, update, and clarification

EMI/EMC tests will be conducted in the HIRF Lab for the IVHM program and 3rd party HIRF lab customers. Hardware modifications, data reduction and analysis for the HIRF Lab will be performed. Existing resources will be integrated to accommodate the diverse requirements of the various experiments conducted in the HIRF Lab [TD1]and related facilities. Reports and presentations will be generated periodically.

2.1 Subtask 1: Electrical Engineering Technician Support. - The Contractor shall perform Electrical Engineering Technician tasks for various experiments to be conducted in the HIRF Lab and related EMI/EMC facilities. The tasks shall include the design and development of mechanical, electrical, and electronic interfaces and components for experimental Devices Under Test (DUTs), HIRF Lab equipment calibration management, amplifier maintenance tests and data, and the conduct of the experiments for the Integrated Vehicle Health Management and other programs at NASA/LaRC. The interfaces shall facilitate instrument control, data acquisition, and DUT monitoring while in the EMI/EMC environment at the facilities and/or off-site. [R3>]***The conduct of experiments shall include setup and measurements for component, composite materials, and airplane tests. Support for the SR22 Unmanned Aerial System (UAS) Project will be required.***[<R3] The Contractor shall develop test systems for the analysis of Electromagnetic Interference and Electromagnetic Compatibility (EMI/EMC) based on customer's requirements. The systems developed shall include hardware installation and operation. The experiments shall be compliant with electromagnetic

immunity/emissions/shielding effectiveness test procedures specified in RTCA/DO-160D, MIL-461/462, IEC-1000-4-3, and emerging related EMI/EMC standards.

2.1.1 Deliverables and Schedule: The Contractor shall provide installed and operational mechanical, electrical, and electronic interfaces for HIRF Lab and related facilities experiments based on the availability of Government provided schedule, data and equipment. Preparation time will be dependent on the extent of modifications and development requested prior to the conduct of experiments and is estimated to be 30 days. The Contractor shall provide test systems for development of lightning effects tests, based on customer's developing Test Methodology. The Contractor shall complete data acquisition, data reduction, reports, and presentations based on customer requirements.

Specific deliverables and schedule are as follows:

1. Complete the redesign and modification of HIRF Lab Safety Interlock system, chamber interface connections and video monitoring and recording systems. (March 09)
2. Development of a system whereby all equipment used in the conduct of EMI/EMC experiments is tracked as to date of experiment and cal dates. (September 2009)
3. Investigate and develop an upgrade of Compu Motor Stirrer Controller System. (September 2009)

2.1.2 Performance Metrics/Standard: Experiment interfaces delivered on schedule with no delay in test schedules and completion on schedule of items 1 and 2 will meet the minimum performance criteria. Delivery of item 3 will exceed the performance criteria. Performance criteria are exceeded if modifications to and troubleshooting of existing Agilent VEE programs or new VEE test programs are generated. Performance criteria are exceeded if time and or cost saving modifications are suggested and implemented, if existing RF systems capabilities are optimized/upgraded, if suggested ancillary testing to meet or enhance research objectives is implemented, or EMI/EMC tests are conducted independent of NASA personnel.

End [R2] block rescope, update, and clarification

2.n Subtask n: **Working Environment Safety and Organization**.

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

4. Other Essential Information: There will be no more than [R1]3 occasions for travel. [R1]Training requirements will be addressed on an as needed basis. [R2>]Travel to Michigan in August and Oklahoma in September may be necessary to support task requirements[<R2]

[R3>]***Travel to Oklahoma State University for Reverberation Chamber Experiment/Theory Course will be required March 30, 2009 – April 3, 2009. Note: This specialized training is required to meet NASA's rapidly changing requirements.*** [<R3]

5. Security Clearance: These activities require a Secret Security Clearance.

6. Period of Performance:

Planned start date: [TD1]January 25, 2007

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

7. NASA Task Management:

Technical Monitor : [R2]Sandra Koppen

M/S:130 Phone: 757-864-6209

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 011D3-NNL07AM21T Revision: 1 Change: 0 Date: October 9, 2008.

Title: **Wind Tunnel Data Acquisition System Maintenance and Improvement**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 20RDA)

The Flight Dynamics Branch (FDB) conducts research to advance the state of the art in analytical and experimental characterization of vehicle stability, controllability, and control power requirements, spin characteristics, flying and handling qualities, agility, and maneuverability. Several wind tunnel test techniques are used as a part of this research. The current techniques include: static force and moment testing, surface pressure testing, power effects testing, test section flow surveys, flow visualization, and dynamic test techniques including forced oscillation, free-to-roll, free-to-pitch, dynamic pitch, free spin, free fall, and rotary balance. Test techniques in development include combined motion (forced oscillation and rotary balance) as well as tools and techniques required for specific research projects. This task pertains to working with new methods of investigating aerodynamic problems and in conducting flight dynamics research using the current and new methods.

Technical Direction 1 (6/16/07): Corrects the task order start date to January 25, 2007 and the completion date to December 31, 2008 (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)

2.1 The Contractor shall provide system administration for FDB data acquisition systems (static and dynamic aerodynamic forces and moments, on- and off-body pressures, video-based motion time histories, etc.), which consists of archive computers, data acquisition computers, and analysis workstations for 12-Foot Low Speed Tunnel (12-Foot), 14x22 Foot Subsonic Tunnel (14x22), 20-Foot Vertical Spin Tunnel (VST), and portable systems used in various other facilities. The Contractor shall:

- Maintain system and acquisition software. Install software upgrades and security patches on a non-interference basis and verify system operations following software upgrades.
- Maintain test database with backups and data archival on a non-interference basis. Backup and archival plan to be approved by task monitor.
- Provide configuration management of the hardware. The Contractor shall develop and maintain a historical configuration tracking log that identifies by date and time all changes, modifications, and upgrades that occur on systems supported by this task.
- Recommend system upgrades and improvements. The Contractor shall monitor user requirements and system performance, availability of updates and upgrades, and make recommendations for system upgrades based on system observations. NASA shall approve all upgrades.
- Diagnose anomalies in the operation of system equipment or software, and provide timely fixes or work-around where possible.

2.1.1 Milestones (Optional):

N/A

2.1.2 Deliverables and Schedule:

- System software is fully operational and kept up-to-date with no significant disruption in capability.
- Proposed schedule for backups and proposed archival scheme.
- Inventory of equipment and software is up-to-date and accurate.

- Systems are kept up-to date with minimum disruption in capabilities due to upgrades
- Systems are operated efficiently with minimal disruption in capability due to malfunctions.

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

- Software Upgrades: Exceeds - "Meets" and improvements are recommended. Meets - upgrades are installed and fully operational in a timely manner with no loss of data.
- Archiving: Exceeds – "Meets" and archiving accomplished without interruption of user processing or data acquisition tasks. Meets – archiving schedules are met.
- Data Format: Exceeds - "Meets" and semi-annual audit finds no deviations from the actual configuration, or improvements have been made in the configuration management system. Meets - format is satisfactory, semi-annual audit finds only minor deviations from actual configuration.
- Approved Upgrades: Exceeds - all upgrades are installed on schedule and without disruption. Meets - all upgrades are installed with only minor delays and disruptions.
- System Efficiency: Exceeds – "Meets" and improvements in efficiency is noted or response time is reduced relative to "Meets". Meets - system tuning is performed and response to problems during prime shift is within 2 hours.

2.2 A plan has been developed to upgrade the data acquisition system, eliminating known shortcomings, maintaining flow of current acquisitions, and incorporating a modular approach. User requirements have been documented in the Vigyan Report R99-05, 'User Requirements for an Upgraded Flight Dynamics Branch Wind Tunnel Data Acquisition System'. The design of the new data acquisition system is documented in Vigyan Report T99-06, 'High-Level Design of an Upgraded Flight Dynamics Branch Wind Tunnel Data Acquisition System'. The system is in the process of being developed. The Contractor shall complete this development. This software shall be developed in accordance to the LaRC software procedure using the control level of high. (LMS-CP 5528 and LMS-CP 5532*)*

2.2.1 Milestones (Optional):

N/A

2.2.2 Deliverables and Schedule:

a) Source code
b) Verification procedures and results of verification
c) Validation test procedures and results
d) Users manual
e) Code installed and compiled on government furnished equipment

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

The completed data acquisition shall meet the criteria specified in the documents listed above. Exceeds: 'Meets" and agreed upon improvements are incorporated in the code. Meets: User requirements listed in the above documents are met, unless otherwise agreed upon by the NASA technical monitor (TM).

2.3 Forced Oscillation/Combined Motion Code for VST: The Contractor shall complete the implementation of the design developed by Vigyan with changes agreed upon by the NASA TM, including final implementation and checkout of rotary, forced oscillation (roll, pitch, and yaw), and combined motion (i.e., simultaneous rotary plus forced oscillation) using upgraded National Instruments motion control hardware (currently installed), and calculation of dynamic derivatives (both "classical" and "specific point" methods) from forced oscillation time histories. The design is described in the document 'Design Recommendations for NASA LaRC 20-Foot Vertical Spin Tunnel Forced Oscillation Data System Upgrade' by Heather P. Houlden, January 2002.

2.3.1 Milestones (Optional):

N/A

2.3.2 Deliverables and Schedule:

Code for forced oscillation/rotary combined motion testing in the 20-Foot Vertical Spin Tunnel

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

Code, including proposed Vigyan design with changes agreed upon by the NASA TM, is implemented into VST combined motion system. Exceeds: "Meets" and code is delivered ahead of schedule. "Meets": Code is available for use with the forced oscillation (roll axis)/rotary combined motion system by March 31, 2007.

2.4 The Contractor shall provide support for the data acquisition computers during FDB testing. This testing shall be done on a one-shift operation, with FDB conducting approximately 8 tests per year. Tunnel schedule will be provided to the Contractor at least two weeks in advance using best information available.

2.4.1 Milestones (Optional):

N/A

2.4.2 Deliverables and Schedule:

Contractor sets up data acquisition computers for tunnel testing when proper notification has been given and contributes to the progress of the test.

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

Exceeds: 'Meets' and makes accessible archived data from previous tests when requested, and provides software updates, when approved, to support the changing test needs. Meets: Contractor provides computer setup for test using a FDB data acquisition system.

2.5 The Contractor shall provide system administration for the additional wind tunnel, data acquisition, and engineering desktop computer systems indicated in Attachment A (Section 4, below). The Contractor shall:

- Install software upgrades and security patches on a non-interference basis and verify system operations following software upgrades.
- Diagnose anomalies in the system operation of equipment or system software and provide timely fixes or work-around where possible.

2.5.1 Milestones (Optional):

N/A

2.5.2 Deliverables and Schedule:

System software is fully operational and kept up-to-date with no significant disruption in capability. The systems are operated efficiently and with minimal disruption in capability due to malfunctions.

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

Exceeds: "Meets" and improvements are recommended. Meets: Software upgrades are installed and fully operational in a timely manner with no loss of data.

Exceeds: 'Meets" and response time is shorter than 'meets criteria'. Meets: Timely response when notified of problem (4 Hours).

2.6 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.

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

2.6.2 Required date: Ongoing.

2.6.3 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:

Task may require integration or modification of hardware. In such cases the government may decide to purchase the required components. These will be provided to the Contractor for integration and modification and may be taken to Contractor site during integration or modifications and checkout. This will be determined on a case-by-case basis and will be decided by the TM for the task

4. Other Essential Information:

Software will be modified and developed in accordance to the LaRC LMS procedures.

Attachment A:

1) Jay Brandon, B1232/R309, ECN 3047768
2) Bruce Owens, Bldg 1232/R313, ECN 2100248 , 1884156, and 1885413
3) Mike Fremaux, B644/R301, ECN 1884156
4) Mike Fremaux, B645/R400, ECN 1882200
5) Austin Murch, B1232/R315, ECN TBD (machine ordered)
6) Dan Vicroy, B1232/R314, Desktop Simulator, ECN N/A
7) Ron Busan, B2132/R317, ECN 3022078

5. Security Clearance:

Task may include support of secure wind tunnel testing. In such cases a secret clearance will be required

6. Period of Performance:

Planned start date: TD1 1/25/07 Completion date: R1 ~~TD1~~ ~~12/31/08~~ ***12/31/09***

7. NASA Task Management:

Technical Monitor (Required): C. Michael Fremaux
M/S:308 Phone: 757-864-1193

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

TASK ORDER NUMBER: 012D3-NNL07AM22T Revision: 4 Change: 0 Date: September 9, 2008

Title: **Electromagnetics Research Facilities Engineering Support**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 17RDI)

Several Research and Technology Directorate (RDT) electromagnetic test facilities serve as focal points for government, industry, and university personnel for performing research. The facilities involved in this task are the Electromagnetics and Sensors Branch's (ESB) Low Frequency Antenna Test Facility (LFATF), Compact Range Test Facility (CRTF), and the Special Access Program Labortory (SAPL). These facilities are used over the 0.1 to 40 GHz frequency range to measure electromagnetic scattering and antenna performance. The purpose of this task is to provide the technical engineering support required for conducting this research.

Revision 1 (8/27/07): Extends the period of performance three months to March 31, 2008 in continuation of NASA's support, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007 (see [R1] below).

Technical Direction 1 (10/1/07): clarifies safety and organization Subtask 2.n (see [TD1] below).

Revision 2 (11/14/07): Extends the period of performance 9 months to December 31, 2008, in continuation of NASA's support and updates the title of Subtask 2.3 (see [R2] below).

Revision 3 (4/15/08): Extends the period of performance 6 months to June 30, 2009 in continuation of NASA's support and adds system administrator support for lab computers (see [R3] below).

Revision 4 (9/9/08): Adds requirements as new subtask 2.4 and extends the period of performance 6 months to December 31, 2009 in continuation of NASA's support (see [R4] below).

Technical Direction 2 (9/23/08): Provides missing details in subtask 2.4 deliverables and performance metrics (see [TD2] below).

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

2.1 Low Frequency Antenna Test Facility - This task will provide technical and administrative support for facility operations approximately 80% of the time.

- The Contractor shall provide technical support for the operation of the Low Frequency Antenna Test Facility which includes the coordination of equipment and personnel to accomplish all test requirements.
- The Contractor shall provide time and manpower estimates to accomplish internal and external customer requests.
- The Contractor shall review space act or interagency agreements with the view of technical merit and feasibility.

Deliverables and Schedule:

- technical support for facility operations (ongoing)
- test reports (by customer request)
- conference papers (mutual agreement)
- problem/failure/action reports (episodic)
- estimates needed for pricing work to NASA administration (external requests)

Metrics:

Minimum acceptable performance:

- readiness of facility to support planned tests at least 80% of the time

- skill improvements for present and future requirements
- timeliness of reports, estimates, and documentation

Exceeds minimum performance:

- recommendations for improving efficiency, capability, cost, and quality.
- propose new activities that will benefit the government in achieving the goals of the tasks included herein.

2.2 Compact Range Test Facility - This task will provide technical and administrative support for facility operations approximately 80% of the time.

- The Contractor shall be provide technical support for the operation of the Compact Range Test Facility (CRTF). This support includes the coordination of equipment and personnel to accomplish all test requirements. It is anticipated that electromagnetic scattering and occasional antenna radiation measurements will be performed in the CRTF.
- The Contractor shall provide time and manpower estimates to accomplish internal and external customer requests.
- The Contractor shall review space act or interagency agreements with the view of technical merit and feasibility.
- [R3>]The Contractor shall provide system administrator support for laboratory computers in rooms 152 and 210.[<R3]

Deliverables and Schedule:

- technical support for facility operations (ongoing)
- test reports (for all radar cross section (RCS) tests; otherwise, by customer request)
- problem/failure/action reports (episodic)
- conference technical papers (mutual agreement)
- estimates needed for pricing work to NASA administration (external requests)

Metrics:

Minimum acceptable performance:

- readiness of facilities to support planned tests at least 80 percent of the time
- skill improvements for present and future requirements
- timeliness of reports and documentation

Exceeds minimum performance:

- recommendations for improving efficiency, capability, cost, and quality.
- propose new activities that will benefit the government in achieving the goals of the tasks included herein

2.3 [R2]Advanced Concepts Research Laboratory - This task will require approximately 0.5 WYE. The Contractor shall provide consultative and programmatic support for special access programs (as identified) that require coordinated planning with other government agencies and industry (as needed) for laboratory measurements.

Deliverables and Schedule:

- Documented in contract-required monthly progress reports

Metrics:

Minimum acceptable performance:

- readiness of facilities to support planned tests at least 50 percent of the time
- skill improvements for present and future requirements
- timeliness of reports and documentation

Exceeds minimum performance:

- recommendations for improving efficiency, capability, cost, and quality.
- propose new activities that will benefit the government in achieving the goals of the tasks included herein.

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

2.4 Low Temperature Mechanism (LTM) and Mechanisms Development Lab (MDL)- The Contractor shall provide support of LTM project actuator life testing and for the development of the MDL. Lunar Exploration will require mechanism technology capable of operating at temperatures as low as 40 degrees Kelvin and to last for up to five years. LTM is evaluating and developing technology to meet these needs. The Contractor shall support development of the MDL and conducting test and development activities for the LTM effort. This task will require multidiscipline skills in mechanical and electrical engineering.

The Contractor shall provide similar support for the Electronic System Branch in building and making molds for different airplane models.

******Begin Technical Direction TD2 Block Clarification******

Deliverables and Schedule:

- test reports (two weeks following the conclusion of each measurement program)
- mechanical design, fabrication, and installation of support hardware (ongoing)
- test set-up, lab construction and set-up (ongoing)

Metrics:

Minimum acceptable performance:

- Assembly of the measurement system and a facility operation readiness above 75% meets the performance criteria.
- Timely delivery of reports and data meet performance criteria.

Exceeds minimum performance:

- Early delivery of reports and data, or on-time delivery when delays due to customer changes or equipment are encountered will exceed performance criteria.
- Test and measurement planning including meeting with personnel to determine test requirements, establishing a test schedule, establishing a test methodology, and planning for fabrication of test fixtures when required all exceed the minimum performance criteria.
- Recommendations for improving current operations capability, efficiency, cost, or quality exceed performance criteria

******End Technical Direction [TD2] Block Clarification******

*.**End [R4] block addition***

2.n Working Environment Safety and Organization

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: Access to test facilities, including use of instrumentation for model support and positioning and data collection, office space, specialized computers, test equipment, solvent reservoirs, solvents, cleaning agents, and related items will be made available to the Contractor from existing laboratory resources to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work will be performed in NASA LaRC Buildings 1299, and 1293 on a non-interference basis.

4. Other Essential Information: Occasional one to two day travel per month in support of subtasks 2.3 will be required

5. Security Clearance: Secret clearance with LBI (Limited Background Information)

6. Period of Performance:

Planned start date: [R1]1/25/2007

Completion date: [R1]~~12/31/07~~ [R2]~~3/31/08~~ [R3]~~12/31/08~~ [R4]~~6/30/09~~ ***12/31/09***

7. NASA Task Management:

Technical Monitor (Required): Allen Langford

M/S: 490 Phone: (757) 864-1846

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 013D3-NNL07AM23T Revision: 2 Change: 0 Date: October 15, 2008	
Title: **Computational Electromagnetics Research**	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 18RDI with possible incumbent staff retention)
The objective of this task is to develop enhancements to the computational electromagnetics capabilities of the Electromagnetics and Sensors Branch.

Revision 1 (9/24/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the schedule, updates the initial task order start date to January 25, 2007, redefines some requirements for the new period of performance, and re-designates safety and organization subtask as 2.n and clarifies its requirements (see R1 below).
Revision 2 (10/15/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support, updates the schedule, and redefines/clarifies some requirements for the new period of performance (see R2 below).

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

The Contractor shall perform the following subtasks:

R1>2.1 Material investigations:
The Contractor shall investigate properties of electromagnetic materials (EM) in support of the Aging Aircraft program. Modeling shall be performed using government owned COTS EM modeling packages and may include both designed materials used in nondestructive diagnostic imaging systems (negative index of refraction materials) as well as conventional materials such as those used in aircraft wiring. The Contractor shall use the COTS EM codes to investigate potential material parameter determination techniques by simulating S-parameter measurements for various sample configurations such as filled and partially filled coaxial sample holders.<R1

2.1.1 Deliverables and Schedule:
(1) Final written report detailing modeling effort and results (Due R1~~September 28, 2007~~ R2~~September 30, 2008~~ ***December 31, 2009***.)

2.1.2 Performance Metrics/Standard:
Meets - Delivery of final report on schedule

2.2 Modeling, R1data analysis, R2***and test support***:
The Contractor shall perform EM modeling R1and data analysis in support of ongoing programs. The modeling shall be performed using government owned COTS EM modeling as well as other application-specific codes. Parametric studies shall be conducted to in which various model parameters are varied to optimize results. R2>***The Contractor shall support experiments through facility setup, maintenance programming, and data acquisition. The Contractor shall assist in transitioning data acquisition to LabView.***<R2

2.2.1 Deliverables and Schedule:
(1) Final written report detailing modeling effort and results (Due R1~~September 28, 2007~~ R2~~September~~

~~30, 2008~~ ***December 31, 2009***.)

2.2.2 Performance Metrics/Standard:
Meets - Delivery of final report 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 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: The Government will provide office space, facilities, government data, access to government specialized computer equipment, access to existing ESB and AA specialized software codes and specialized commercial software on an as-needed basis to accomplish the task objectives.

4. Other Essential Information:

5. Security Clearance: Secret

6. Period of Performance:

Planned start date: R1 1/25/2007 Completion date: R1 ~~12/31/2007~~ R2 ~~12/31/2008~~ ***12/31/2009***

7. NASA Task Management:

Technical Monitor (Required): Robin Cravey
M/S: 490 Phone: 757 864 1819

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 014D3 Revision: 2 Change: 0 Date: July 14, 2008	
Title: **Grid Generation Support for Large-Scale Aerodynamic Applications**	

1. Purpose, Objective, or Background (Optional): (Follow-on to SAMS Task 04RBB Revision 14)

- *Provide grid generation support to Configuration Aerodynamics Branch and supporting customers*. - The task will involve the construction of unstructured and structured computational grids around complex aerospace configurations. Grid requirements and specifications will be provided to the Contractor on a case-by-case basis. An expert knowledge of the TetrUSS unstructured grid generation tools,VGRID and GridTool, is required for this task.

- *Provide maintenance of graphics upgrades and new capabilities into VGRID* – The VGRID software is still evolving, and new capabilities are being added to the code at Langley. An expert knowledge of OpenGL graphics is required to maintain, upgrade, and add new graphics capabilities to VGRID and other supporting codes.

Revision 1 (3/12/07): Corrects/updates the period of performance to start January 25, 2007 and end September 30, 2008, and clarifies number of computational grids in Subtask 2.1 as "per year" basis (see [R1] below).
Revision 2 (7/14/08): Extends completion date from September 30, 2008 to September 30, 2009, updates the requirements under Subtask 2.2, and clarifies safety and organization Subtask 2.n (see [R2] 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.

2.1 (NOC) Grid Generation and Application Support Activity.
The CONTRACTOR WILL generate up to 30 computational grids [R1] per year on selected complex aerospace configurations that require numerical simulation under the supporting projects. CAB will coordinate priorities, requirements and specifications for the grids to the Contractor on a case-by-case basis. The grids will be suitable for advanced Euler and Navier-Stokes unstructured flow solvers such as USM3D and FUN3D.

2.1.1 Deliverables:
a) Geometry setup files for each activity
b) Computational grid files for each activity
c) Monthly log of grid generation activity

2.1.2 Performance Metrics/Standard and Schedule
Minimum acceptable performance/Schedule:
a) Numerical grids shall be completed within 2 weeks for an unstructured inviscid Euler application, and 3 weeks for a viscous Navier-Stokes application. Times are with respect to approved NOC date.
c) Computational grids must adequately resolve regions of major flow features.
d) Within one week following the completion of a grid-generation activity all computer files are saved on a mass storage device and logged with sufficient documentation to render the files useful for future computations.

Exceeds performance: Completion of tasks 1 week prior to MAP completion date.

2.2 Maintain and implement new graphics capabilities in R2***Linux GridTool and*** VGRID Version 4.0

Although graphics in R2***Linux GridTool and*** VGRID is based on standard Graphics Libraries (OpenGL), its implementation for different platforms and operating systems still requires minor modifications, adjustments, and testing for each system. In addition, new developments in R2***Linux GridTool and*** VGRID require new graphics capabilities. The CONTRACTOR SHALL provide services intended to support the graphics requirements of the R2***Linux GridTool and*** VGRID system Version 4.0 R2***and higher***.

2.2.1 Milestones:

a) Development of graphics capabilities for display of surface sources in GridTool and VGRID by R2~~5/31/07~~ ***3/31/09***.

~~b) Development of graphics capabilities for display of prismatic grids in VGRID by 9/28/07.~~

2.2.2 Deliverables and Schedule:

a) CVS controlled source code of modified GridTool and VGRID Version 4.0 with upgrades of graphics, make files, and test cases.

2.2.3 Performance Metrics/Standard:

Minimum acceptable performance (MAP)/Schedule:

a) Complete implementation and testing of graphics capabilities for display of surface sources in GridTool and VGRID by R2~~5/31/07~~ ***3/31/09***.

~~b) Complete implementation and testing of graphics capabilities for display of prismatic grids in VGRID by 9/28/07.~~

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:

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: [R1]January 25, 2007 Completion date: [R2~~R1~~]~~September 30, 2008~~ ***September 30, 2009***

7. NASA Task Management:

Technical Monitor: Neal T. Frink
M/S: 499 Phone: 757-864-2864

TASK ORDER NUMBER: 015D3-NNL07AM25T Revision: 2 Change: 0 Date: October 16, 2008

Title: **High Performance Computer Support**

1. Purpose, Objective, or Background (Optional): (Follow-on to SAMS task order 16RDC)
The purpose of this task is to provide setup, configuration and maintenance for high performance linux clusters, as well as several linux workstations and laboratory PCs. This support includes system setup, routine maintenance (backups, security patches), as well as trouble calls and hardware upgrades.

Revision 1 (6/6/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support requirements (see [R1] Section 6, below).
Revision 2 (10/16/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support and re-designates safety and organization subtask as 2.n with clarification (see [R2] below).

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

The Contractor shall be responsible for maintenance and improvements to a high performance computer system, as well as linux workstations and several multi-user access windows machines. Maintenance tasks include running daily incremental backups, applying vendor supplied security patches, and occasional updates to commercial software. Improvements include hardware upgrades to disk space and memory as well as overall system replacement and proper disposal of excess equipment. All work involving networked computers shall be done according to NASA Center Procedures including:

LMS-CP-5518 Granting Foreign Nationals and Foreign Representatives Computer Accounts
LMS-CP-5915 Obtaining Two-Factor Authentication Credentials and a Virtual Private Network (VPN) Account.
LMS-CP-5550 Cleaning and Excess of Computer Hard Drives and other IT-Related Nonvolatile Storage
LMS-CP-5696 Accessing Network Services through the Center Firewall
LMS-CP-5549 Responding to Reports of Information Technology Security (ITS) Incidents and Inappropriate Activity

Subtask 2.1: System Maintenance and Administration

On a set of approximately 24 nodes configured in 2 linux high-performance computer clusters, 15 linux workstations, 5 windows machines, and 12 network printers the following services are expected:

- The Contractor shall verify operation of daily backup system and provide both full restore and per-file restore services for users as requested.
- The Contractor shall apply linux security patches and quarterly updates as released.
- The Contractor shall install windows security patches for systems with VMWare windows emulation software and for multi-user windows machines (shared laptops, lab and conference rooms).
- The Contractor shall provide preventative maintenance annually and respond to trouble calls on network printers.
- The Contractor shall debug and repair hardware related problems.
- The Contractor shall install disk drive and memory upgrades as required.
- The Contractor shall dispose of excess computers through Langley's surplus system, including cleaning of hard drives and coordinating with property custodian.
- The Contractor shall assist in configuration of remote-access authentication systems associated with HSPD-12 compliance.

2.1.1 Milestones (Optional):
None

2.1.2 Deliverables and Schedule (Required):
Inspection of status of backups – daily
Checking availability of security patches – daily
Preventative maintenance of printers – annual for each printer, approximately on printer per month.
Responding to trouble calls – same day email/phone response, next day on-site response.

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

Meets:

- 4-hour response (phone/email) to urgent trouble calls
- next day on-site response to urgent trouble calls
- 72-hour (post release) install of security patches
- 2-week (post release) install of quarterly upgrades
- 97% availability of daily backups, 99.5% availability of weekly backups

Exceeds:

- 2-hour response (phone/email) to urgent trouble calls
- 4-hour on-site response to urgent trouble calls
- 48-hour(post-release) install of security patches
- 99% availability of daily backups, 100% availability of weekly backups.

[R2]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***.

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 linux computer system will be provided for use by the Contractor in performing system maintenance duties. Hardware required for repairs or upgrades will be purchased by the government.

TASK ORDER NUMBER: 015D3-NNL07AM25T Revision: 2 Change: 0 Date: October 16, 2008

Title: **High Performance Computer Support**

4. Other Essential Information:

5. Security Clearance:

6. Period of Performance:

Planned start date: Jan 25, 2006 Completion date: R1 ~~December 31, 2007~~ R2 ~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): **David E. Cox**

M/S:308 Phone: 864-6658 Email: d.e.cox@larc.nasa.gov

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 016D3-NNL07AM26T Revision: 3 Change: 0 Date: April 3, 2009

Title: **IDEAS Lab Enhancement**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 15RDE)

The Crew Systems and Aviation Operations Branch has a continuing responsibility to conduct human (specifically, although not limited to, pilot) performance studies of Flight Deck Systems Concepts. The purpose of this task is to enhance the Intermediate Design Evaluation and Simulation (IDEAS) Lab located in Building 1268 to support these activities.

Revision 1 (10/22/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n with clarified requirements (see R1 below).

Revision 2 (9/30/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see R2 below, Section 6).

Revision 3 (4/3/09): Extends the period of performance 12 months to December 31, 2010 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)

2.1 Simulation and Display Development

The Contractor shall develop simulations and displays as specified in the *Experiment Requirements Documentation* supplied by the PI(s).

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

(a) Models and software developed
DELIVERED in the timeframe indicated in the *Experiment Requirements Documentation*.

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

(a) Time to deliver the simulations and displays as specified in *Experiment Requirements Documentation* supplied by the PIs.
MEETS if 80% of the requirements are available with no slippage.
EXCEEDS if 80% of the requirements are completed 2 weeks early from the PI requirement.

2.2 Simulation and Display Modification

The Contractor shall provide the capability of modifying the simulation and/or displays developed in Subtask 2.1 in near real-time as required by the PI(s). (Note: This refers to the rapid prototyping capability of the IDEAS Lab.).

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

(a) Models and software developed
DELIVERED in the timeframe indicated by the PI(s) in consultation with the contractor task lead.

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

(a) Time to deliver modifications.
MEETS if 70% of the modifications are completed by the agreed upon schedule.
EXCEEDS if 90% of the modifications are completed by the agreed upon schedule.

2.3 Simulation, Display, and Hardware Maintenance

The Contractor shall maintain the hardware and software developed in Subtask 2.1 pre-, during, and post-experimental runs as specified in the *Experiment Requirements Documentation* supplied by the PI.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

(a) Models and software developed
DELIVERED in the timeframe indicated in the *Experiment Requirements Documentation.*

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

(a) Functionality of the hardware and software developed in Subtask 2.1 pre-, during, and post-experimental runs.
MEETS if 70% of the time functionality of the hardware and software developed in Subtask 1 pre- and during experimental runs is available as dictated by the experiment schedule.
EXCEEDS if 90% of the time functionality of the hardware and software developed in Subtask 1 pre-, during, and post-experimental runs is available as dictated by the experiment schedule.

2.4 Simulation and Display Operation

The Contractor shall provide for the capability of having others start the hardware and software developed in Subtask 2.1.

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required):

(a) Documentation for operation and use of hardware and software
DELIVERED in the timeframe indicated in the *Experiment Requirements Documentation.*

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

(a) Ability of having others start the hardware and software developed in Subtask 2.1.
MEETS if 2 people can start the hardware and software.
EXCEEDS if directions are available for the PI(s), Technical Monitor, and contracting personnel related to this task to start the hardware and software.

2.5 Questionnaire Development

The Contractor shall generate detailed questionnaires (both layout and content) for experiments detailed in Subtask 2.1 in consultation with the PI(s).

2.5.1 Milestones (Optional):

2.5.2 Deliverables and Schedule (Required):

(a) Subject questionnaires
DELIVERED within the timeframe indicated in the *Experiment Requirements Documentation.*

(b) Subject questionnaire layout
DELIVERED within the timeframe indicated in the *Experiment Requirements Documentation.*

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

(a) Delivery time of the subject questionnaires.
MEETS if subject questions are received by the PI(s) with no schedule slippage.
EXCEEDS if subject questions are received by the PI(s) 2 weeks early.

(b) Delivery time of the subject questionnaire layout.
MEETS if subject questions are received by the PI(s) with no schedule slippage.
EXCEEDS if subject questions are received by the PI(s) 2 weeks early.

2.6 Subjective Data Analysis Preparation

The Contractor shall detail and categorize written and verbal comment data from experiments detailed in Subtask 2.1 in conjunction with the PI(s).

2.6.1 Milestones (Optional):

2.6.2 Deliverables and Schedule (Required):

(a) Comment data post-processing and analysis
DELIVERED within 6 weeks after the experiment is completed.

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

(a) Delivery time of comment data.
MEETS if comment data are received 6 weeks after an experiment is completed.
EXCEEDS if comment data are received 4 weeks after an experiment is completed.

2.7 Estimated Experiment Costs and Requested Schedule Changes

The Contractor shall report to the task monitor by experiment the estimated cost of and estimated schedule for Subtasks 2.1 – 2.6.

2.7.1 Milestones (Optional):

2.7.2 Deliverables and Schedule (Required):

(a) Report of estimated costs and schedule
DELIVERED within 2 weeks after the *Experiment Requirements Documentation* is received by the contractor.

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

(a) Delivery time of cost estimate and schedule report.
MEETS if report is received 2 weeks after the *Experiment Requirements Documentation* is received by the contractor.
EXCEEDS if report is received 1 week after the *Experiment Requirements Documentation* is received by the contractor.

2.8 Actual Experiment Costs

The Contractor shall report to the task monitor by experiment the cost of Subtasks 2.1 – 2.7.

2.8.1 Milestones (Optional):

2.8.2 Deliverables and Schedule (Required):

(a) Report of costs by experiment
DELIVERED within 4 weeks after the experiment is completed.

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

(a) Delivery time of cost report.
MEETS if report is received 4 weeks after the experiment is completed.
EXCEEDS if report is received 3 weeks after the experiment is completed.

2.9 IDEAS Lab Manual and Code Documentation

The Contractor shall update the operational manual and code documentation with the additions made in Subtasks 2.1 – 2.6.

2.9.1 Milestones (Optional):

2.9.2 Deliverables and Schedule (Required):

(a) Documentation of models and software developed
DELIVERED within 2 months after the experiment is completed.

(b) Documentation for operation and use of hardware and software
DELIVERED within 2 months after the experiment is completed.

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

(a) Delivery time to update the operational manual and code documentation with the additions made in Subtasks 2.1 – 2.6.
MEETS if update is completed 2 months after the experiment is completed.
EXCEEDS if update is completed 1 month after the experiment is completed.

2.10 Configuration Management and Hardware Plan Maintenance

The Contractor shall continue implementing the configuration management software and hardware plan for the IDEAS Lab developed in the previous Task Order.

2.10.1 Milestones (Optional):

2.10.2 Deliverables and Schedule (Required):

(a) Configuration management
DELIVERED when the experiment is completed or when new hardware and/or software is implemented in the IDEAS Lab.

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

(a) Ability to demo previous experiments (from the Natural Manipulation Experiment (*i.e.*, data glove experiment) and on) conducted in the IDEAS Lab.
MEETS if able to demo within 3-day notice.
EXCEEDS if able to demo within 1-day notice.

2.11 Migration from SGIs to PCs

The Contractor shall continue migrating the IDEAS Lab simulation capabilities to a PC platform from the SGI platform.

2.11.1 Milestones (Optional):

2.11.2 Deliverables and Schedule (Required):

(a) Baseline simulation code runs on PC platform
DELIVERED by January 31, 2007.
(b) Baseline display code runs on PC platform
DELIVERED by February 28, 2007.
(c) Control inceptors (sidestick, yoke, throttles, data glove) run on PC platform
DELIVERED by March 15, 2007.

2.11.3 Performance Metrics/Standard (Required - Meets, Exceeds

(a) Delivery time of platform changes.

MEETS if completed on time.
EXCEEDS if completed 3 weeks early.

2.12 Personnel Participation

The Contractor shall provide knowledgeable personnel in the areas of the simulation during data runs, and for pictures, videos and demonstrations.

2.12.1 Milestones (Optional):

2.12.2 Deliverables and Schedule (Required):

(a) Knowledgeable personnel
DELIVERED by the time requested by the PI in the *Experiment Requirements Documentation* or by the IDEAS Lab manager.

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

(a) Delivery time of knowledgeable personnel.
MEETS if delivered on time.
EXCEEDS if delivered on time with the availability of backup personnel.

[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:

1. IDEA Lab (Silicon Graphics Workstations, PCs, side stick controllers, peripheral hardware, lab space for facility configuration and operation)
2. Engenuity Simulation System Software (*e.g.*, VAPS, FLSIM)
3. *Experiment Requirements Documentation* supplied by the PIs
4. Written and verbal comment data supplied by the PI(s)

4. Other Essential Information: The *Experiment Requirements Documentation* supplied by the PI(s) will be provided to the contractor once the PI(s) obtain a sign-off of the plans by the IDEAS Lab manager (currently Anna Trujillo).

TASK ORDER NUMBER: 016D3-NNL07AM26T Revision: 3 Change: 0 Date: April 3, 2009

Title: **IDEAS Lab Enhancement**

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines.

6. Period of Performance:

Planned start date: [R1]January 25, 2007 **Completion date:** [R1]~~December 31, 2007~~

[R2]~~December 31, 2008~~

[R3]~~December 31, 2009~~

December 31, 2010

7. NASA Task Management:

Technical Monitor (Required): Anna C. Trujillo

M/S: 152 Phone: 757-864-8047

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 017D3-NNL07AM27T Revision: 3 Change: 0 Date: 4/28/08

Title: [R2]**Collision Avoidance for Airport Traffic (CAAT) Technology Development and Evaluation**

1. Purpose, Objective, or Background (Optional) (This PWS is a follow-on to SAMS (NAS1-00135) task order 13RDF.)

The Next Generation Air Transportation System (NextGen) concept for 2025 envisions the safe, efficient, and reliable movement of large numbers of people and goods throughout the air transportation system in a way that is consistent with national security objectives. The NextGen will remove many of the constraints in the current air transportation system, support a wider range of operations, and deliver an overall system capacity up to 3 times that of current operating levels. In order to achieve this vision, research is necessary in the areas of surface traffic optimization, maximum runway capacity, reduced runway occupancy time, simultaneous single runway operations, and terminal area conflict prevention, among others.

Revision 1 (4/16/07): Adds and clarifies some requirements, updates deliverables and schedule, re-designates safety and organization subtask as "2.n", and updates the initial task order start date (see [R1] below).
Revision 2 (11/8/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support with updated, added, and clarified requirements and updated title (see [R2] below).
Revision 3 (4/28/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with no immediate changes in current requirements (see [R3] below).

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

When conducting the subtasks defined below, the Contractor shall follow good programming practices such as configuration management and code documentation (e.g. commenting) and by adhering strictly to LMS CP-5528 (see http://lms.larc.nasa.gov for this procedure).

2.1 [R2]*Collision Avoidance for Airport Traffic (CAAT):*

The Contractor shall modify the existing Runway Incursion Prevention System (RIPS) for conflict detection and resolution in the terminal area [R2]and evaluate the capability as follows:

2.1.A [R2]*Low Altitude Conflict Detection Capability* - The Traffic Alert and Collision Avoidance System (TCAS) is an airborne system that predicts a penetration to an aircraft's airspace, displays potential threats, and provides aural traffic advisories (TA) and resolution advisories (RA) to the flight crew. TCAS generates a TA or RA only when airborne and to approximately [R2]500 feet above ground level (AGL) on approach and above 1100 feet AGL on departures. The Contractor shall develop conflict detection capability (requirements, algorithms, and alerting) for the phase of final approach where neither TCAS or RIPS generates traffic alerts [R1](low altitude), for current NAS operations and traffic levels. The Contractor shall integrate this capability with TCAS and RIPS. The Contractor shall incorporate results of a feasibility study conducted under SAMS contract NAS1-00135 Task 13RDF and requirements provided by NASA. The Contractor shall utilize the [R2]Conflict Scenario Simulator (CSS) developed by Morgan State University (see subtask 2.3) to evaluate the algorithms during development, provided the [R2]CSS is equipped to evaluate this functionality. [R1>]The Contractor shall also [R2]generate and utilize data generated in the Air Traffic Operations Laboratory (ATOL) [R2]data to evaluate the algorithms during development[<R1 R2>]as necessary. The low altitude conflict detection capability shall be enhanced based on the evaluations conducted under 2.1.F.[<R2]

2.1.B [R2]*Taxi Conflict Detection Capability* - The Contractor shall develop initial conflict detection capability (requirements, algorithms, and alerting) for taxi and ramp operations for multiple classes of aircraft as well as surface vehicles (trucks, baggage carts, etc.) for current NAS operations and traffic levels. The Contractor shall incorporate requirements provided by NASA. The Contractor shall utilize the [R2]CSS (see subtask 2.3) to evaluate the algorithms during development, provided the [R2>]CSS is equipped to evaluate this functionality. The taxi and ramp conflict detection capability shall be enhanced based on the evaluations conducted under 2.1.F[<R2]

Begin [R2] block addition/update

2.1.C *RSM Cautionary Alerting Capability* - The Contractor shall expand the Runway Safety Monitor (RSM) by adding cautionary or traffic advisory (TA) capability (requirements, algorithms, and alerting) for current NAS operations and traffic levels. Based on past research results, the cautionary capability shall only be added to the approach phase of flight and when in position and hold on the runway. Cautionary alerts should not be generated during the departure and taxi operational phases. The Contractor shall utilize the CSS (see subtask 2.3) to evaluate the algorithms during development, provided the CSS is equipped to evaluate this functionality. The RSM cautionary alerting capability shall be enhanced based on the evaluations conducted under 2.1.F.

2.1.D *Conflict Resolution Capability* - The Contractor shall develop conflict resolution capability (requirements, algorithms, and advisories), similar to that of TCAS, for all conflicts detected in the terminal area (low altitude, runway, and taxiway/ramp). The Contractor shall incorporate requirements provided by NASA. The Contractor shall utilize the CSS (see subtask 2.3) to evaluate the algorithms during development, provided the CSS is equipped to evaluate this functionality. The conflict resolution capability shall be enhanced based on the evaluations conducted under 2.1.F.

2.1.E *CAAT Concepts and Requirements Documentation* - The Contractor shall develop a report documenting the CAAT aircraft-based terminal area conflict detection and resolution concepts and requirements. The report is intended to be a 'living document' that shall be updated as concepts and requirements are enhanced as a result of evaluations.

a. The first phase of the report shall include concepts and requirements for runway incursion prevention (developed previously under the Aviation Safety Program), low altitude conflict detection (developed under subtask 2.1.A), and taxi conflict detection (developed under subtask 2.1.B).

b. The report shall be amended to include concepts and requirements for conflict resolution developed under subtask 2.1.D.

c. The report shall be updated based on any changes or enhancements made to the runway incursion, low altitude, or taxi conflict detection and resolution concepts and requirements based on the evaluations conducted under 2.1.F and concepts and requirements for RSM cautionary alerting capability (developed under subtask 2.1.C).

2.1.F *CAAT Piloted Simulation Evaluation* - The Contractor shall support two piloted simulation studies in the Cockpit Motion Facility (CMF) to evaluate CAAT. Data collection is scheduled to occur in 3Q and 4Q FY08. Although the experiments are in the planning stages, it is anticipated that the contractor shall provide support in the areas of simulator implementation, integration, testing, validation, and test scenario development. The Contractor shall also be available to ensure correct software functionality and data logging during the piloted experiments, as necessary. The Contractor shall also support data analysis as specified in 2.2.

2.1.G *CAAT Monte Carlo Evaluation* – The Contractor shall conduct an analysis of the CAAT incursion detection and resolution algorithms using a Monte Carlo simulation. Current plans are to conduct the simulation in the ATOL in 2Q FY09. An alternate plan is to use the CSS (see subtask 2.3) to conduct the simulation. During this task period, the Contractor shall assist in scenario and simulation definition, assist in the integration of the CAAT algorithms into the ATOL (or CSS), complete initial implementation of the defined scenarios in the ATOL (or CSS), and assist in the development of a method for data logging in the ATOL (or CSS).

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

2.1.2.1 Report (final version) as specified under 2.1.E.a (11/30/07)
2.1.2.2 Initial software developed under 2.1.A and 2.1.B (12/31/07)
2.1.2.3 Report as specified under 2.1.E.b (12/31/07)
2.1.2.4 Initial software developed under 2.1.C (3/31/08)
2.1.2.5 Initial software developed under 2.1.D (6/30/08)
2.1.2.6 Report as specified under 2.1.E.c (12/31/08)
2.1.2.7 Enhanced CAAT software (12/31/08)

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

Meets:

- Adherence to scheduled delivery date.
- Software real-time performance demonstrated (>12 Hz).
- 90% accuracy for conflict prediction for 2.1.A, 2.1.B, 2.1.C, 2.1.D.

Exceeds:

- Delivery 30 days prior to scheduled delivery date.
- 95% accuracy for conflict prediction for 2.1.A, 2.1.B, 2.1.C, 2.1.D

2.2 CAAT Data Analysis:

The Contractor shall provide data analysis support for CAAT technologies as requested by NASA. The Contractor shall deliver digital data files in the format specified by NASA. The Contractor shall conduct performance and statistical analysis of data as specified by NASA. The Contractor shall document results through Contractor Reports as required by NASA.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

- Digital data files delivered within 20 days after data request made.
- Performance and statistical analysis delivered within 30 days of request.
- Contractor Reports delivered within 180 days of request.

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

Meets:

- Adherence to scheduled delivery date.

Exceeds:

- Delivery ahead of schedule as follows:
  - o Digital data files within 15 days of request.
  - o Performance and statistical analysis within 20 days of request.
  - o Contractor Reports within 150 days of request.

2.3 Conflict Scenario Simulator (CSS) Development Support:

A desk-top simulator is being developed by the Chesapeake Information Based Aviation Consortium (CIBAC) (particularly Morgan State University) to evaluate terminal area conflict detection algorithms developed by NASA in both real-time and fast-time simulations for various terminal area scenarios. The Contractor shall provide technical support for development of this desk-top simulator. The Contractor shall provide CAAT software and documentation to CIBAC in the specified format as requested. The Contractor shall serve as a consultant to CIBAC for CAAT technical issues and desk-top simulator requirements, design, and development. After each CSS delivery, the Contractor shall verify and validate the desk-top simulator for adherence to design requirements and proper operation and document via a white paper report

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

- Delivery of CAAT software and documentation in the specified format for transfer to CIBAC within 30 days of request.
- Report (white paper) documenting the verification and validation of the desk-top simulator within 120 days of simulator delivery.

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

Meets:

- Adherence to scheduled delivery date.

Exceeds:

- Delivery of software and documentation within 15 days of request.
- Delivery of report (white paper) 30 days or more ahead of schedule.

End R2 block addition/update

2.4 Technology Transfer Activities:

The Contractor shall support transfer of [R2]CAAT technology to private industry and other agencies as required by NASA. NASA will provide the Contractor with software technology transfer requests. The Contractor shall provide the [R2]CAAT software in the specified format for delivery to the requesting company/agency. The Contractor shall also serve as consultants to integrate the software in the requestor's facility. NASA will ensure that the proper paperwork (Software Usage Agreement) is in place before the software is transferred.

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required):

- Delivery of [R2]CAAT software in specified format for transfer to requesting company/agency within 60 days of request.

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

Meets:

- Adherence to scheduled delivery date.

Exceeds:

- Delivery within 45 days of request.

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.

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 [R1]will provide all essential equipment, computers, and software development tools. The government [R1]will also provide access to required laboratories, simulation facilities, and test aircraft.

4. Other Essential Information:

5. Security Clearance: This is unclassified work.

6. Period of Performance:

Planned start date: [R1]January 25, 2007 Completion date: [R2]~~December 31, 2007~~

[R3]~~December 31, 2008~~

December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Denise R. Jones

M/S: 152 Phone: 757-864-2006

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 018D3-NNL07AM28T Revision: 4 Change: 0 Date: September 17, 2008

Title: **ATOL Enhancements and Simulation Support**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 28RDD)

The purpose of this task is to enhance the capabilities of the NASA Airspace and Traffic Operations Lab (ATOL), currently located in Building 1268A, [R1]and its resident simulation, the Airspace and Traffic Operations Simulation (ATOS). The enhancements will support both piloted and batch workstation simulation studies of new air traffic management (ATM) concepts, algorithms, displays, and guidelines developed under the Next Generation Air Transportation System ([R4]***NextGen***) ATM Airspace Project, which is part of the NASA Airspace Systems Program. This task also involves participating as necessary to support NASA researchers as they design and conduct the simulation studies and analyze the resulting data.

The enhancements of the ATOL/[R1]ATOS include extending and/or modifying the current capabilities of the lab's internal and external communications architectures, and integrating new simulation components supplied by NASA or other contractors into the existing lab. In addition, this task will also require specific modifications to individual software components of the [R1]ATOS to support a particular experiment or series of experiments.

Many of these activities will be performed in cooperation with other on-site and off-site contractors to NASA. Close coordination with these other contractors will be required, although all direct task guidance will come directly from the NASA Technical Monitor.

In general, the subtasks under this task order are to be completed by [R4]***December 31, 2009***.

Revision 1 (1/29/07): Adds technical and travel requirements; adds security, formatting, and background clarifications; updates schedule; and documents addition of a second technical monitor (see [R1] above and below).
Revision 2 (2/22/07): Adds requirements under Subtask 1 (see [R2] below).
Revision 3 (9/24/07): Extends the period of performance and schedule 12 months in continuation of NASA's support, re-designates safety and organization subtask as 2.n and clarifies its requirements, and updates the initial task order start date to January 25, 2007 (see [R3] above and below).
Revision 4 (9/17/08): Extends the period of performance and schedule 12 months to December 31, 2009 in continuation of NASA's support with some added clarifications and updates (see [R4] above and 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. Support the integration of the Research Prototype Flight Management System (RPFMS) with successive builds of the NASA-supplied Aircraft Simulation for Traffic Operations Research (ASTOR). This task will require close cooperation with both on-site and off-site contractors working under other contracts

Begin [R2] block addition

and may require modifications to other ATOS software modules, including the simulation manager, traffic manager (TMX), data recording and playback utilities, and the ASTOR communications management functions. Specific sub-tasks will include:

A. Modifying the RPFMS, simulation manager, and other ATOS simulation modules to manage simulation time via several different techniques including "best-effort" real-time, "lock-step" time (for repeatable batch runs), and any others that may be required. Simulation frame size (time increment) must also be a configurable parameter.

B. Modifying the RPFMS, simulation manager, and other ATOS simulation modules to transition between simulation modes in a completely controllable and deterministic way, such that multiple scenarios can be flown with a given ASTOR without having to kill and restart any processes.

One or both of these sub-tasks may depend on other software modifications made by on-site or off-site contractors working under other contracts or made by NASA personnel.

End R2 block addition

Begin R1 block addition

2. Enhance the capabilities of the RPFMS by developing a new capability for trajectory generation and guidance that complies with all imposed constraints, provided a solution is possible for the specified constraints. The new capability shall be designed to relax constraints if necessary, and the design shall allow for future variation of optimization strategies, constraint relaxation strategies, and tolerances. Integrate the capability into the existing RPFMS R4***and ATOS***. The product shall consist of
   A. New functionality to be designed in partnership with NASA, R4>***the NextGen Airspace Project***,<R4 and GFI document, "Capabilities Required for Research Prototype Four Dimensional FMS, Version 1.0."
   B. Design documentation
   C. Software implementation in C++, which includes an option to revert to the conventional RPFMS capability. The product shall be capable of pilot-in-loop operation using ASTOR.

End R1 block addition

3. Enhance the capabilities of the RPFMS by developing sets of detailed airframe and engine performance data for several different aircraft types, possibly including (but not limited to) the Boeing B-777-200, the Boeing B-747-300/400, the Airbus A-330/340 family, and the Boeing B-737 family.
4. Enhance the capabilities of the RPFMS by implementing easily adjustable (parameterized) levels of navigation performance, communications performance, and required time of arrival (RTA) performance
5. Enhance the capabilities of the RPFMS by implementing advanced simulation time management techniques to better support robust real-time operation as well as fast-time batch runs.
6. Enhance the capabilities of the RPFMS by designing and implementing enroute step-climb prediction and execution capability, including the computation of optimum cruise altitudes and the proper changes in flight phase during cruise climbs and descents.
7. Enhance the capabilities of the RPFMS by modifying the trajectory generation code to use the predicted EPR (thrust) limit values for each route segment, to properly model (and report) thrust modes in each of the various flight phases, R4>***and new techniques for blending of measured and forecast winds for trajectory prediction.***<R4
8. Review the RPFMS code base and perform "code cleanup" tasks, such as eliminating duplicate structure or class definitions, using a single set of common global constants, substituting enumeration types for numeric values where appropriate, and restructuring the code to better prepare it for the implementation or integration of known future capabilities. Also create the appropriate workspace files and make any code changes necessary for the RPFMS code to compile and link using the Eclipse Integrated Development Environment (IDE) using the GNU C++ compiler in addition to the current (and future) versions of the Microsoft Visual C++ IDE. The RPFMS code base should eventually build from both the Eclipse and Visual C++ IDEs under the Windows operating system, and from the Eclipse IDE under Linux, and should run identically in all cases.
9. Design and implement software to support the simultaneous execution of up to five R4>***PCPlane, RPFMS/4D-FMS***<R4 combinations, each of which can be individually accessed and controlled by a single set of flight deck displays and controls (e.g., PFD, ND, EICAS, MCP, EFISCP, XCP, ACP, and

MCDU). The purpose of this task is to create a pseudopilot station on which a researcher can run multiple aircraft simultaneously on the same machine, and can switch his displays/controls from communicating with one simulation to another and back again as needed.

10. Provide to the NASA Technical Monitor a detailed schedule for the work under Subtasks 1 through 9, including expected start date and duration for the individual tasks that make up each Subtask. The individual tasks for each Subtask shall be identified on the basis of their duration (e.g., more than a day or so of effort) or their level of importance to the completion of the Subtask (e.g., critical capabilities that impact the progress of other tasks).
11. Report to the NASA Technical Monitor brief weekly updates of the schedule provided in Subtask 10, showing any changes, additions, or deletions to the individual tasks within each Subtask and any changes in the completion status of the individual tasks within each Subtask.
12. Contribute to the development of simulation and in-flight evaluation research plans, including conceptual algorithm development, statistical experiment design, scenarios for the experimental runs, selection criteria for test subjects, performance of the experimental runs with test subjects, and recommendations for modifications to ATOL or onboard flight system software to support the research goals.
13. Design and implement modifications to individual components of the [R4]***ATOS*** as specified in any NASA-approved *Experiment Requirements Documentation* or *System Modification Documentation* supplied by the NASA Technical Monitor.
14. Report to the NASA Technical Monitor, by experiment or modification, the estimated cost and schedule for completing the work under Subtasks 12 and 13.
15. Report to the NASA Technical Monitor, by experiment or modification, the cost of Subtasks 13 and 14.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Deliverables:

(1) Software developed.
(2) Concepts, algorithms, and scenarios developed, and other experimental support provided.
(3) Schedule and requirements documentation.
(4) Documentation for architecture design and operational use of software.
(5) Report of estimated costs by experiment from Subtask 14.
(6) Report of costs by experiment from Subtask 15.

Schedule:

(a) Subtask 1 is expected to be an ongoing task, and shall end on [R4]***December 31, 2009***.
(b) Subtask 2 shall be [R1]delivered by [R4]***December 31, 2009***.
(c) Subtask 3 shall be completed by (TBD).
(d) Subtask 4 shall be completed by (TBD).
(e) Subtask 5 shall be completed by (TBD).
(f) Subtask 6 shall be completed by (TBD).
(g) Subtask 7 shall be completed by (TBD).
(h) Subtask 8 shall be completed by (TBD).

(i) Subtask 9 is expected to be an ongoing task, and shall end on [R4]***December 31, 2009***.
(j) Subtask 10 shall be delivered [R1]by [R4]***February 15, 2009***.
(k) Subtask 11 shall be completed [R1]by [R4]***December 31, 2009***.
(l) The brief weekly schedule updates described in Subtask 11 shall be delivered by 4:00 p.m. Eastern Time on the last scheduled workday of each week.
(m) Subtask 13 shall be delivered in the timeframe indicated in the *Experiment Requirements Documentation* or *System Modification Documentation*.
(n) Subtask 14 shall be delivered within 2 weeks after the *Experiment Requirements Documentation* or *System Modification Documentation* is received by the contractor.
(o) Subtask 15 shall be delivered within 1 month after the experiment or modification is completed.

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

a. Delivery of the schedule and requirements documentation for Subtasks 1-9.
MEETS if delivery is 2 weeks from time the contractor receives the task order.
EXCEEDS if delivery is less than 2 weeks from time the contractor receives the task order.
b. Adherence to the software delivery schedule for Subtasks 1-9.
MEETS if required software delivered as specified in schedule.
EXCEEDS if delivered as specified in expedited delivery schedule.
c. Adherence to the software documentation delivery schedule for Subtasks 1-9.
MEETS if software documentation delivered within 2 weeks of software.
EXCEEDS if delivered as specified in expedited delivery schedule.
d. Delivery of the schedule and requirements documentation for Subtasks 12 and 13.
MEETS if delivery is 2 weeks from time the Contractor receives the *System Modification or Experiment Requirements Documentation.*
EXCEEDS if delivery is less than 2 weeks from time the Contractor receives the *System Modification or Experiment Requirements Documentation.*
e. Delivery time of cost estimate report for Subtasks 12 and 13.
MEETS if delivery is 2 weeks from time the contractor receives the *System Modification* or *Experiment Requirements Documentation.*
EXCEEDS if delivery is less than 2 weeks from time the contractor receives the *System Modification* or *Experiment Requirements Documentation.*
f. Time to deliver the required software as specified in *System Modification or Experiment Requirements Documentation* supplied by the *NASA* for Subtasks 12 and 13.
MEETS if required software delivered as specified in schedule.
EXCEEDS if delivered as specified in expedited delivery schedule.
g. Delivery time of cost report for Subtasks 12 through 14.
MEETS if report is received 1 month after an experiment is completed.
EXCEEDS if report is received 2 weeks after an experiment is completed.

2.n Working Environment Safety and Organization

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:

1. Air Traffic Operations Lab (ATOL), including multi-monitor Windows NT/2000/XP Workstations, peripheral hardware, and lab space for facility configuration and operation
2. Aircraft Simulation for Traffic Operations Research (ASTOR) software
3. NASA-supplied FastWin (CDU/FMS/PCPlane) software with integrated merging/self-spacing algorithms
4. NASA-supplied Autonomous Operations Planner (AOP) software
5. *Experiment requirements documentation* or *system modification documentation* supplied by the NASA Technical Monitor

Begin [R1] block addition

6. NASA Innovative Partnership Program Seed Fund Proposal, "Four-Dimensional Flight Management to support the Next Generation Air Transportation System ([R4]***NextGen***)"
7. Requirements document, "Capabilities Required for Research Prototype Four Dimensional FMS, Version 1.0."

End [R1] block addition

4. Other Essential Information: [R1]Travel requirements: Four person-trips of two days duration each to Grand Rapids, MI or domestic locations of similar cost.

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines. [R1]The Contractor shall comply with NASA security requirements applicable to employment of foreign nationals.

6. Period of Performance:

Planned start date: [R3]January 25, 2007 Completion date: [R3]~~December 31, 2007~~ [R4]~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitors (Required):

Michael T. Palmer
M/S: 156A Phone: 757-864-2044

[R1]**Anthony M. Busquets**
M/S: 156A Phone: 757-864-6652

TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 019D3-NNL07AM29T Revision: 4 Change: 0 Date: November 19, 2008

Title: **Global Pressure and Temperature Sensing Paints (PSP/TSP)**

1. Purpose, Objective, or Background (Optional)

This Task Order represents a continuation of SAMS NAS1-00135 Task Order 27RBG and involves the production of advanced pressure-sensitive paint (PSP) and temperature-sensitive paint (TSP) technology in support of NASA LaRC advanced diagnostic development and implementation.

Revision 1 (2/12/07): Adds deliverables to tasks 2.2 and 2.4 to reflect additional wind tunnel tests that need support in FY07, renumbered deliverables, and re-designates safety and organization subtask as "2.n" (see [R1] below).
Revision 2 (07/24/2007): Extends the period of performance one year to 12/31/08 in continuation of NASA's support requirements, changes schedule for task 2.1, adds deliverable to task 2.2, changes dates for task 2.4 due to tunnel test slippage, changes deliverable date for task 2.4, and adds new subtask 2.5. Also updates the initial task order start date to January 25, 2007 (see [R2] below).
Revision 3 (02/07/2008): Extends the period of performance for subtasks 2.3 and 2.4 to 12/31/08 in continuation of NASA's support requirements, adds deliverables to subtasks 2.2, 2.3, and 2.4 (with deliverable renumbering), and clarifies safety and organization Subtask 2.n (see [R3] below).
Revision 4 (11/19/2008): Extends the period of performance one year to 12/31/2009 in continuation of NASA's support requirements with updated subtasks 2.1, 2.2, 2.3, and 2.4 schedules, adds deliverables to subtasks 2.2 and 2.4, and annotates completed deliverables in subtasks 2.2, 2.4, and 2.5 (see [R4] below).

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

2.1 PSP and TSP Formulations for Application to Models:

The Contractor shall produce PSP and TSP formulations in sufficient quantities for application to models targeted for wind-tunnel tests at NASA Langley and other installations. Successful completion of Subtask 1 will require: a) determination of the optimum paint formulation for each test, and b) characterization of the pressure and temperature sensitivity and physical characteristics of each formulation applied to test models.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

1. A detailed summary report that includes: a) paint characterization data from for each wind-tunnel test, and b) SOP (standard operating procedure) for the preparation, application and removal of each paint system delivered for wind tunnel operations.

Schedule of Deliverables: Subtask 1 shall be completed by [R4>]~~[R2>]December 31, 2007 December 31, 2008[<R2]~~ ***December 31, 2009***[<R4] Paints shall be provided to meet the yet-to-be-determined wind-tunnel testing deadlines.

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

Meets Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 Deliverables meeting the specifications provided in the Description of Work for Subtask 1 by the completion date specified for Subtask 1.

Exceeds Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 deliverables with improvements in paint formulation and/or the development of application techniques that require less than two hours, and meeting all other requirements provided in Subtask 1 Description of Work by the completion date specified for Subtask 1.

2.2 PSP and TSP Cryogenic Formulations:

The Contractor shall develop, characterize, and implement PSP and TSP formulations that exhibit adequate pressure and temperature sensitivity over broad ranges of temperature (-150 - 50°C) and pressure (vacuum – 30 psia) to enable testing in cryogenic facilities.

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

2. A detailed summary report that includes: a) paint formulation preparation and application/removal protocols, and b) pressure/temperature sensitivity and surface roughness/thickness characterization data.
3. (R4 ***Completed***) R1>Provide an adequate supply of cryogenic Pressure Sensitive Paint (approximately eight (8) ounces) and technical support for a wind tunnel test at the National Transonic Facitiliy (NTF) at NASA Langley Research Center to occur sometime between the months of April to June.<R1
4. (R4 ***Completed***)R2> Provide an adequate supply of cryogenic Pressure Sensitive Paint (approximately eight (8) ounces) and technical support for a wind tunnel test at the National Transonic Facitiliy (NTF) at NASA Langley Research Center to occur sometime in FY08 (to be determined).<R2
5. (R4 ***Completed***)R3>Provide an adequate supply of Temperature Sensitive Paint (approximately eight (8) ounces per application) and technical support for a wind tunnel test at the National Transonic Facility (NTF) at NASA Langley Research Center to occur in March FY08. Formulations supplied may be for cryogenic and/or ambient temperature testing.<R3
6. R4>***Provide an adequate supply of either Temperature Sensitive Paint or Pressure Sensitive Paint (depending on application) and technical support for wind tunnel tests at the National Transonic Facility (NTF) at NASA Langley Research Center to occur during FY09. The test schedule is tentative, but may include: 1) transition detection on a wing using TSP; 2) aerodynamic loads measurement using PSP on the Common Research Model; and 3) aerodynamic loads measurement using PSP on a circulation control concept.***<R4

Schedule of Deliverables: Subtask 2 shall be completed by R4>~~R2>December 31, 2007~~ ~~December 31, 2008.<R2~~ ***December 31, 2009.***<R4

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

Metrics for Performance-Based Contracting")

Meets Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 Deliverables meeting the specifications provided in the Description of Work for Subtask 2 by the completion date specified for Subtask 2.

Exceeds Performance standards shall be deemed as having been met with the on-time within-cost Subtask 2 deliverables with a demonstration of a suitable formulation in the National Transonic Facility in R4***FY09***, and meeting all other requirements provided in the Subtask 2 Description of Work by the completion data specified for Subtask 2.

2.3 Measurement Approaches for Hypersonic Test Facilities:

The Contractor shall design and integrate PSP measurement approaches that exhibit adequate pressure and temperature sensitivity over broad ranges of temperature (20 – 200°C) and pressure (vacuum – 30 psia) to support testing in hypersonic test facilities.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

R16. A detailed summary report that includes: a) paint formulation preparation and application/removal protocols, b) pressure/temperature sensitivity and surface roughness/thickness characterization data, and c) PSP results from facility tests.

R3>7. Provide PSP and/or TSP formulations and support for a series of tests to be completed in facilities such as the 20-inch Supersonic Wind Tunnel and the Supersonic Low Disturbance Tunnel.<R3

Schedule of Deliverables: Subtask 3 shall be completed by R4>~~R3>December 31, 2007 December 31, 2008<R3~~ ***December 31, 2009***<R4.

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

Meets Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 Deliverables meeting the specifications provided in the Description of Work for Subtask 3 by the completion date specified for Subtask 3.

Exceeds Performance standards shall be deemed as having been met with the on-time within-cost Subtask 3 deliverables with a demonstration of a suitable formulation in a hypersonic facility (e.g. 31-Inch Mach 10 at LaRC) in FY07, and meeting all other requirements provided in the Subtask 3 Description of Work by the completion data specified for Subtask 3.

2.4 PSP Systems for Rotorcraft Applications:

The Contractor shall support the development and deployment of PSP systems for rotorcraft applications. This shall include the development and evaluation of high frequency PSP formulations capable of measuring pressure fluctuations greater than 100 Hz as well as developing a data acquisition system for measuring pressure distributions on rotorcraft blades as well as surface in forward flight or hover.

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required):

R1 8. A detailed summary report that includes: a) paint formulation preparation and application/removal protocols, b) system design and performance characteristics, and c) PSP results from facility tests.

R1> 9. (R4 ***Completed***)Provide an adequate supply of Pressure Sensitive Paint (approximately sixteen (16) ounces) and technical support for a Rotorcraft wind tunnel test at the 14x22 Wind Tunnel at NASA Langley Research Center to occur sometime between the months of R2>June to August September to October<R2.<R1

R3> 10. (R4 ***Completed***)Provide an adequate supply of pressure Sensitive paint and Temperature Sensitive Paint (approximately sixteen (16) ounces each) and technical support for a Rotorcraft wind tunnel test at the Hover Test Cell at NASA Langley Research Center to occur between the months of February and April.<R3

R4> ***11. Provide an adequate supply of Pressure Sensitive Paint and technical support for a Rotorcraft wind tunnel test at the 14x22 Wind Tunnel at NASA Langley Research Center to occur sometime between the months of July to September 2009.***<R4

Schedule of Deliverables: Subtask 4 shall be completed by R4>R3>R2>~~December 31, 2007 March 30, 2008~~>R2 ~~December 31, 2008~~<R3 ***December 31, 2009***.<R4

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

Meets Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 Deliverables meeting the specifications provided in the Description of Work for Subtask 4 by the completion date specified for Subtask 4.

Exceeds Performance standards shall be deemed as having been met with the on-time within-cost Subtask 4 deliverables with a demonstration of a suitable formulation and/or system in a Rotorcraft test in FY07, and meeting all other requirements provided in the Subtask 4 Description of Work by the completion data specified for Subtask 4.

Begin R2 block addition

2.5 Generation of Microscale Polystyrene Particles

The Contractor shall support the development of methodologies to create microscale polystyrene particles for wind tunnel applications. This shall include the development of robust, repeatable process for creating batches of polystyrene particles of known and repeatable sizes, as well as investigating methods to produce microscale particles for higher temperature applications.

2.5.1 Milestones (Optional):

2.5.2 Deliverables and Schedule (Required):

11. ([R4]***Completed***)A detailed summary report that includes: a) methods and formulations for making polystyrene microscale particles, b) system design and performance characteristics, and c) results from wind tunnel tests as appropriate.
12. ([R4]***Completed***)Provide five (5) batches of polystyrene microscale particles that have an average size of 1.6 – 1.8 μm. Each batch will contain at least three (3) litres of a suspension of particles in water or a water-ethyl alcohol mixture.

Schedule of Deliverables: Subtask 5 shall be completed by December 31, 2008.

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

Meets Performance standards shall be deemed as having been met with the on-time within-cost Subtask 5 Deliverables meeting the specifications provided in the Description of Work for Subtask 5 by the completion date specified for Subtask 5.

Exceeds Performance standards shall be deemed as having been met with the on-time within-cost Subtask 5 deliverables with the addition of providing batches of microscale polystyrene particles of average sizes ranging from 0.9 μm to 2.2 μm, and meeting all other requirements provided in the Subtask 5 Description of Work by the completion data specified for Subtask 5.

End [R2] block addition

2.n Working Environment Safety and Organization:

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:

Office and laboratory space will be provided in Building 1200. Desk/work areas with specialized desktop computers, printers, and software and supplies will be provided. All chemical resources required to produce the PSP formulations and all specialized hardware requirements discussed in the Subtasks will be provided for these efforts.

4. Other Essential Information:

The Contractor(s) may be required to travel to support testing in other facilities or to interact with experts and present experimental results.

5. Security Clearance: All work will be unclassified.

6. Period of Performance:

Planned start date: [R1]1/25/2007 Completion date: R4>~~R2>12/31/2007~~
~~12/31/2008<R2~~
12/31/2009<R4

7. NASA Task Management:

Technical Monitor (Required): Dr. A. Neal Watkins
M/S: 493 Phone: 757-864-4741

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 020D3 Revision: 1 Change: 0 Date: February 12, 2007	
Title: **Chemical Sensor System Development**	

1. Purpose, Objective, or Background (Optional)

This Task Order encompasses the production and characterization of sensor skin technologies that contribute to vehicle autonomy and areas suitable for Exploration. This Task Order represents a continuation of SAMS NAS1-00135 Task 29RBG.

Revision 1: Descopes requirements in subtask 2.1 and re-designates safety and organization subtask as 2.n (see R1 below).

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

2.1 Methodologies for the Production of Sensor Skin Technologies:

1. The Contractor shall develop methodologies for the production of sensor skin technologies that contribute to aerospace and exploration objectives. Sensor coating capable of detecting a variety of analytes (e.g. ammonia or carbon monoxide) shall be developed depending upon customer need. These coatings shall be based on inductor-capacitor circuits capable of being used for a variety of applications.

   2.1.1 Milestones (Optional):

   2.1.2 Deliverables and Schedule (Required):

   1. A detailed written SOP for preparing and implementing the sensor elements.
   2. A detailed written report for electrical interrogation of sensor skin elements.
   3. Construction and delivery of R1 ***two (2)*** sensors capable of measuring gaseous analytes such as ammonia (NH_3), humidity, etc
   4. R1 ***Deleted***

   Schedule of Deliverables: Subtask 1 shall be completed by December 31, 2007.

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

   Meets Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 Deliverables meeting the specifications provided in the Description of Work for Subtask 1 by the completion date specified for Subtask 1.

   Exceeds Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 deliverables with development and demonstration of a flexible inductor-capacitor sensor capable of detecting at least two different analytes simultaneously, and meeting all other requirements provided in Subtask 1 Description of Work by the completion date specified for Subtask 1.

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 and laboratory space will be provided in Building 1200. Desk/work areas with specialized desktop computers, printers, and specialized software and supplies will be provided in addition to all specialized laboratory-based equipment, materials, and supplies.

4. Other Essential Information:

The Contractor(s) may be required to travel to a suitable professional meeting to present results from developmental efforts, interact with researchers within the field, and investigate state-of-the-art measurement science instrumentation.

5. Security Clearance: All work will be unclassified.

6. Period of Performance:

Planned start date: 1/02/2007 Completion date: 12/31/2007

7. NASA Task Management:

Technical Monitor (Required): Dr. A. Neal Watkins

M/S: 493 Phone: 757-864-4741

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 4
TASK ORDER NUMBER: 021D3-NNL07AM31T Revision: 5 Change: 0 Date: April 10, 2009	
Title: **AirSTAR Testbed Development and Support**	

1. Purpose, Objective, or Background (Optional) (Support for this effort has been provided under SAMS task order 25RDC.)
A system of subscale experimental flight vehicles [R5>]***(or unmanned aircraft systems (UAS))***[<R5], ground support equipment, and associated instrumentation known as the AirSTAR (Airborne Subscale Transport Aircraft Research) testbed is being assembled to support the Integrated Resilient Aircraft Control project. The system will enable flight experiments on remotely piloted vehicles to explore off-nominal portions of the flight envelope that are associated with loss of control (LOC) incidents and damage conditions. Such an experimental capability is critical to the design and testing of control algorithms that can mitigate damage and recover from upset conditions, as well as other LOC precursors.

The vehicles range from commercially available radio control models to custom built and dynamically scaled models of full-scale aircraft. The simpler models represent generic flight characteristics and allow for parametric testing over a range of conditions. The dynamically scaled models represent specific flight characteristics of full-scale aircraft and have application in validating technologies for these vehicles.

*****Begin [R5] block addition*****
To enable flight experiments to be executed in the National Airspace (NAS) the Federal Aviation Administration (FAA) requires the proper certifications and authorizations to allow the AirSTAR UAS to fly in the NAS. In order for NASA to fly UAS in the NAS, the FAA requires a Certificate of Authorization (COA) to be issued for UAS vehicles, the type of operation the vehicle will be used, and the location where the vehicle will be flown in the NAS. The AirSTAR currently has 25+ UAS vehicles in its inventory and two COA's. These vehicles are used for various types of UAS operations including pilot training and proficiency, flight system development and check out, and for research flights where research data is recorded. The FAA requires that a new COA application be filed annually and approved prior to expiration dates. The COA process for obtaining approvals continues to change each year with added requirements that now can take up to 6 months to complete the process for the final approvals. Timeliness in getting through the FAA's COA process is critical to the AirSTAR project in order to maintain its access to the NAS.
*****End [R5] block addition*****

Revision 1 (6/7/07): Extends the period of performance 7 months to July 31, 2008 in continuation of NASA's support requirements, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n (see [R1] below).
Revision 2 (8/27/07): Extends the period of performance 5 months to December 31, 2008 in continuation of NASA's support requirements (see [R2] below, Section 6).
Technical Direction 1 (9/27/07): clarifies safety and organization Subtask 2.n (see [TD1] below).
Revision 3 (7/08/08): Extends the period of performance 9 months to September 30, 2009 in continuation of NASA's support requirements and documents an earlier change in Technical Monitor (see [R3] below, Sections 6 and 7).
Revision 4 (1/16/09): The current 3 WYE effort needs to be re-planned to 2 WYE within the next month to accommodate AirSTAR project downsize for a new phase of flight testing/operations. The previous work description still applies at the new support level.
Revision 5 (4/10/09): Adds requirements as new element 2.3 and updates Section 1 accordingly and extends the period of performance 15 months to December 31, 2010 (see [R5] above and below).

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

2.1 Vehicle Integration and Mechanical Design

- The Contractor shall perform mechanical design and loads analysis associated with various vehicle configurations and ongoing hardware modifications to ensure physical integrity of the vehicle under all anticipated flight or tunnel conditions.
- The Contractor shall perform component testing on any modified or new hardware (e.g. updates to propulsive system, control surface servos, landing gear, etc.) to 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 engine performance and maintenance criteria, engine repair and documentation actions, and to maintain status as certified engine representative to manufactures and end users.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

- Monthly technical reports that detail status of on going work and highlight any concerns with schedule, budget, or technical feasibility.
- Design drawings and as-built documentation for any aircraft modification that will impact structural integrity or mass balance.
- Documentation specifying engine operational criteria and procedures.
- Documentation which records engine maintenance actions and provides engine configuration control.

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

MEETS:

Design drawings and as-build documentation delivered in electronic form within 4 weeks of completion of modification.

EXCEEDS:

Design drawings and as-build documentation delivered in electronic form within 2 weeks of completion of modification.

2.2 Operational Procedures and Safety Assurance

- Contractor shall prepare and maintain equipment inventories and checklists to support the proper deployment of aircraft, mobile operations station(MOS), and all associated ground support equipment for flight operations at remote airfields.
- Contractor shall prepare and maintain operational procedures, as approved by the NASA Langley Airworthiness Safety Review Board (ASRB), and ensure personnel involved in flight activity are

fully aware of these requirements.

- Contractor shall support remote flight operations, including multi-day deployments to Wallops Island.
- Contractor shall support formal Mishap Investigation Boards, as required, and document any close-call incidents.
- Contractor shall support ISO audits, as appropriate, with an emphasis on operational safety.

2.2.1 Milestones:

2.2.2 Deliverables and Schedule:

- Monthly technical reports on status of on-going activities including recommendations of any equipment replacements, upgrades, or other procurements to support safe operations.
- Monthly reports documenting inventories of consumable and non-durable items associated with operations.
- Status presentations to team, and support of program reviews.
- Development, maintenance and distribution of procedures and checklists to personnel involved in operations for each flight test.

2.2.3 Performance Metrics:

MEETS:

Operations procedures continue to achieve approval of ASRB in periodic reviews with little or no change.

Operational and safety procedures consistently followed by team.

EXCEEDS:

No deployment schedule delays due to inadequacy of safety procedures or operations checklists.

If required, mishap investigation documentation is submitted within 2 weeks of mishaps.

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

2.3 FAA

- Interface with the AirSTAR project and the FAA to accomplish the requirements specified in the COA application and approval process

2.3.2 Deliverables and Schedule

- The AirSTAR project currently has COA's to fly in the NAS at Smithfield, Virginia (31VA) and at Allen C. Parkinson Army Airfield (BKT) in Blackstone, Virginia. There is a need to apply for a third COA at the Wallops Island Main Base located on the Eastern shore. A new strategy is also being developed by the AirSTAR project to reduce the risk of COA suspension in the event of a UAS crash. This will involve the submittal of at least 10 more COA's that are specific to a vehicle and type operation
- The Contractor shall keep the government informed of all activities associated with the COA application and renewal process. The Contractor shall respond rapidly and effectively to the

customer's dynamic, unanticipated, and emergency work requirements by restructuring priorities. The Contractor shall report monthly on the status of each COA in process and interface with the FAA to resolve any issues that arise with the applications. Performance metrics will be based on the timely issuance of the COA's and maintaining AirSTAR access to the NAS.

*****End R5 block addition*****

R1 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:

All flight vehicles and other equipment associated with the AirSTAR facility.

Motor vehicles and trailers required to transport equipment for flight test deployment.

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: R1 January 25, 2007

Completion date: R1 ~~December 31, 2007~~ R2 ~~July 31, 2008~~ R3 ~~December 31, 2008~~ R5 ~~September 30, 2009~~ ***December 31, 2010***

7. NASA Task Management:

Technical Monitor (Required): **R3 Ray D. Rhew**

M/S: 238 Phone: 757-864-4705

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 022D3-NNL07AM32T Revision: 2 Change: 0 Date: September 19, 2008

Title: **Advanced Material and Structural Mechanics, Analysis, and Testing**

1. Purpose, Objective, or Background (Optional) (Ref: SAMS Task Order Number(s) 06RCD, 03RFF and 17RCE)

The objective of this task is: (1) to conduct research and technology development that evaluates concepts, quantifies behavior, durability, and damage tolerance, validates analysis tools, and validates performance of advanced materials and structures for aerospace applications in all flight environments, including the extreme environments associated with hypersonic trans-atmospheric and atmospheric entry. The Contractor will be expected to perform the following general requirements as applicable to specific subtasks:

- Conduct thermal, structural and thermal-structural analyses and design studies, CAD design, and analysis of test specimens, and support for testing of advanced Thermal Protection Systems (TPS), hot structures, cryogenic tanks, fuselage and launch vehicle structures for use on advanced space transportation systems and aircraft in support of Langley programs.
- Conduct structural analyses and design studies, CAD design, analysis of test specimens, and support for testing of advanced materials and structures representative of airframe, spacecraft, and space transportation systems in support of Langley programs.
- Conduct design, analysis, and evaluation of advanced structural concepts for future aircraft, spacecraft, space transportation, and lunar/planetary operations.

Revision 1 (2/12/08): Extends the period of performance 5 months to March 31, 2009, in continuation of NASA's support, updates the initial task order start date to January 25, 2007, re-designates safety and organization subtask as 2.n with clarified requirements, documents a change in Technical Monitor, and changes Alternate POC (see [R1] below).
Revision 2 (9/19/08): Extends the period of performance 9 months to December 31, 2009 in continuation of NASA's support (see [R2] below).
Technical Direction 1 (02/13/09): Documents move of David Brewer from POC to Technical Monitor (see [TD1] 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. 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 Overall Requirement: The Contractor shall provide technical progress reporting and full financial reports at the individual subtask level in the monthly reports to the Task Technical Monitor

SUBTASK 1: (NOC) Conduct Thermal and Thermal-Structural Studies of Advanced Space Transportation and High-Speed Aircraft Integrated Thermal-Structural Systems, and Develop Theoretical and Algorithmic/Non-Optimum Structural Weights

1.1 The Contractor shall conduct thermal and/or thermal-structural analyses and design studies of advanced cryogenic tanks, hot structures, and TPS. These analyses and design studies will support advanced concept development and design/analysis methods development/ validation with application to advanced space transportation and high-speed aircraft.
   - The Contractor shall identify load requirements and shall provide initial loads estimates.

- The analyses shall include aerodynamic, acoustic, thermal, and mechanical loading conditions representative of advanced space transportation or high-speed aircraft as appropriate.
- Various design options for vehicle concept, structural arrangement, material systems, and integrated wall concepts for cryotanks, wings, other primary structures, and TPS will be considered.
- Thermal and structural analyses shall be performed to size and compare integrated TPS/cryotank systems and to determine response and deflections of the aerosurfaces under load.
- Analysis will also be required for design of specific test panels and to support development/validation of new design/analysis methods.

Deliverables and Schedule:

- Finite element models and results suitable for presentation
- Short written reports of design studies, analyses and weight trades of various concept studies

Schedule to be specified in NOC.

Performance Measurements:

Minimum Performance

- The finite element models shall accurately represent the system being investigated and be of sufficient resolution to predict the responses of interest.
- The trade study results shall accurately represent the various thermal-structural concepts.

Exceeding Minimum Performance

Contractor would exceed the minimum performance by meeting <u>one or more</u> of the following metrics:

- Suggestions of design improvements based on the Contractor-performed 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
- Performing studies in a more rapid manner than original time estimates

1.2 (NOC) 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.) shall be used to develop weight

estimates for non-modeled structural items.

- Methodology for developing total airframe weights based on a limited number of point sizings (at discrete locations) shall be developed and applied to the airframe concepts being considered in the trade studies.

Deliverables and Schedule:

- Detailed weight statements for integrated airframe concepts
- Algorithms for estimating weights of non-modeled structural features
- Written reports of analytical results

Schedule to be specified in NOC.

Performance Measurements:
Minimum Performance

- Development of itemized weight statements and theoretical/algorithmic weight estimates using established analytical weights methods
- Integration of outputs from current structural/TPS sizing codes into the detailed weight statements

Exceeding Minimum Performance
The Contractor would exceed the minimum performance by meeting one or more of the following metrics:

- Suggesting improvements to structural concepts based on the Contractor-performed 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
- Perform studies in a more rapid manner than original time estimates.

SUBTASK 2: Advanced Structural Concept and Test Hardware Design

2.1. (NOC) The Contractor shall develop designs and hand and/or CAD drawings of NASA-defined advanced structural concepts. Drawings may include trade study concepts, structural layouts, and components to be fabricated to demonstrate salient features of an advanced structural concept. The Contractor shall coordinate fabrication of the designed components through the LaRC fabrication system.

Deliverables and Schedule:

- Drawings of designs suitable for presentation or fabrication.
- Implementation of selected designs into hardware.

Schedule to be specified in NOC.

Performance Measurements:
Minimum Performance
The designs shall clearly illustrate the salient features of the concepts and those intended for fabrication shall be adequate for a competent fabricator to be able to fabricate the concept.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with either of the following metrics:
- Suggestions of design improvements
- Finding more rapid or more cost effective means to complete deliverables

2.2. (NOC) The Contractor shall develop designs and CAD drawings of fixtures based on the requirements for each specific test.
- Specific items that may be designed include:
  a. concepts and drawings for cryo/elevated temperature chambers
  b. load introduction and specimen support fixtures for structural, thermal, or thermal-structural tests
  c. preparation jigs for specimen handling and assembly.
- The Contractor shall coordinate the fabrication of the designed fixtures through the LaRC fabrication system.
- The Contractor designer shall provide consultation to the NASA technician staff to support final assembly of test hardware.

Deliverables and Schedule:
- CAD drawings of fixture designs
- Implementation of selected designs into hardware

Schedule to be specified in NOC.

Performance Measurements:
Minimum Performance
- The design for the test fixtures shall be adequate for a competent machinist to be able to fabricate the test fixture.
- The assembled fixtures shall be delivered to appropriate testing lab in a timely manner.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with either of the following metrics:
- Suggestions of design improvements
- Finding more rapid or more cost effective means to complete deliverables

SUBTASK 3: Structural and Thermal-Structural Test Support

3.1. (NOC) The Contractor shall perform the following requirements for specimens to be tested:

- Perform pre-test analyses
- Write and/or modify test plans
- Execute test request form if required by test facility
- Determine instrumentation layouts
- Expedite specimen preparation
- Assist in final test preparations
- Track the test series
- Perform post-test analysis/test correlation.
- Provide periodic reports of progress of the test support activity to the Technical Monitor

Deliverables and Schedule:

- The Contractor shall deliver the analyses, test plans, and instrumentation layouts in electronic and printed form.
- The Contractor shall deliver the test specimens and hardware to the appropriate testing laboratory and support the test series as specified in the NOC.
- The Contractor shall deliver progress reports documenting the tests in electronic form.

Schedule to be specified in NOC.

Performance Measurements:

Meets-

- Completes documents for the analyses, test plans, and instrumentation layouts
- Monitors progress of preparation of test articles for testing, execution of the test plan, and removal of the test article.

Exceeds- All subtask elements are completed and all deliverables are met ahead of schedule

SUBTASK 4: Structural Mechanics Test and Analysis Support

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

- Structural response of composite aircraft, spacecraft, or space transportation systems with and without stiffness discontinuities
- Evaluation of the effects of manufacturing defects and impact damage on structural residual strength
- Evaluation of failure criteria for laminated composite structures
- Analytical and experimental evaluation of inflatable/deployable structures for space-based structural systems
- Structural behavior of high-temperature adhesives and composite materials
- Development of structural panels with novel stiffening concepts such as multi-layer grid-stiffening or selective reinforcement
- Maintenance and improvements to advanced measurement systems to monitor full-field

structural deformations and strains
- Structural trade studies for advanced aircraft, development of advanced joining concepts for aircraft and spacecraft structures
- Structural stability analyses
- Nonlinear structural analysis of built-up structural systems.

Deliverables and Schedule: Specific deliverables and schedule to be defined in individual NOC's. In general deliverables will include:
- Finite element models and analytical results
- Test specimens prepared for testing
- Test fixtures
- Support fixtures
- Reduced test data
- Summaries of analysis and test results suitable for presentation and publication
- Progress reports documenting the design, analysis, test status in electronic form

Performance Measurements:
Minimum Performance
- Completion of required analyses and tests to meet schedule and milestones
- The analyses shall recover all required quantities.
- Tests conducted in accordance with written test plans and adherence to accepted test and safety practices

Exceeding Minimum Performance
The Contractor would exceed the minimum performance by meeting one or more of the following metrics:
- Completing required analyses and tests ahead of schedule
- Providing suggestions for improvements to analysis methods and modeling practices
- Suggesting improvements to the instrumentation or test methods being utilized
- Suggesting improvements to the design of the structural concepts or test articles

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.

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 Structures and Materials Laboratory in B1148, Materials Research Laboratory in Building 1205, Thermal Structures Laboratory in B1256C, and the Combined Loads Test System (COLTS) in B1256.
- Other specialized measurement and testing equipment
- STAGS, NASTRAN, and ABAQUS nonlinear structural analysis codes
- 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 1 - 4 : 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 1-4: **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.

5. Security Clearance:

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

6. Period of Performance:

Planned start date: R1 1/25/2007 Completion date: R1 ~~10/31/2008~~ R2 ~~3/31/2009~~

12/31/2009

7. NASA Task Management:

Technical Monitor (Required): [T1]***David N. Brewer***

M/S: 190 Phone: 757 864 ***3558***

Other POC (Optional):

M/S: hone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 023D3-NNL07AM33T Revision: 3 Change: 0 Date: February 5, 2008
Title: **Virtual Diagnostics Interface (ViDI) Development**

1. Purpose, Objective, or Background (Optional) (This subtask continues enduring work performed under SAMS Task Order 25RBG.)

The objective of this Task Order is the continued development of Virtual Diagnostics Interface (ViDI) technology and its derivative software applications such as LiveView3D. ViDI and LiveView3D utilize advanced three-dimensional computer graphics to facilitate the design and use of advanced instrumentation systems in aerospace testing environments (wind tunnels). Funding for this work comes from numerous sources, including the NASA Fundamental Aeronautics Program, the Aeronautics Test Program, Exploration, and external customers.

Revision 1 (2/21/07): Increases the number of tests to be supported in Subtasks 2 and 3, adds new Subtasks 4 (with travel) and 5, and re-designates safety and organization subtask as "2.n" (see R1 below).

Revision 2 (7/5/07): Adjusts/extends the schedules of subtasks 1.0 through 3.0, extends the overall task order period of performance 13 months to December 31, 2008, updates quantity of anticipated tests, incorporates the NOC feature, adds travel to subtask 4.0, adds a high priority Air Force subtask 6, adds non-disclosure requirements, and updates the initial task order start date to January 25, 2007 (see R2 below).

Revision 3 (2/5/08): Updates Subtask 1 and adds new Subtask 7 technical requirements with reliance on Notices of Clarification (NOCs), notes the completed status of Subtasks 4-6, extends the period of performance of the task and active subtasks through December 31, 2009 with some clarifications in anticipated activity, and adds the potential requirement for small purchases (see R3 below).

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

Begin R2 block addition

Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. The Contractor shall further develop and utilize Virtual Diagnostic Interface (ViDI) technology to support NASA's testing requirements in aerospace test facilities. Specifically, the contractor shall utilize ViDI to assist in test planning, real time data visualization, and post-test data analysis and display. The NASA requirement for this work is expected to endure through 12/31/08. Notices of Clarification (NOC) will be issued to define the NASA requirements and funding sources as the work is requested by NASA programs and/or reimbursable customers. See NOC designated item(s) and description below.

End R2 block addition

Begin R3 block update

2.1 Subtask 1 (NOC): The Contractor shall perform upgrades and enhancements to ViDI and LiveView3D software for increased capability. This includes development of new algorithms and general use code modules that advance ViDI / LiveView3D capabilities, maintenance of pre-existing code to ensure compatibility with new hardware and software, development and maintenance of software documentation and training materials, and development and implementation of configuration control and software release activities. A minimum of five major software update activities (defined as requiring more than 120 hours to complete) shall be performed under this subtask. Notices of clarification to this subtask will be issued to define specific work elements as they develop. This subtask covers ViDI / LiveView3D code development and work to be performed from March 1, 2008 through December 31, 2009.

End R3 block update

- Software routines shall be operable on PC-compatible computers running Windows XP or higher.
- The software shall be written in either Microsoft Visual Basic, Microsoft C/C++, or Autodesk 3DS MaxScript.
- The software routines shall be fully documented.
- The documentation shall include version information, compiler information, lists of function prototypes, descriptions of the functionality of each routine, software / hardware dependencies, known bugs / issues, and interface mechanisms.
- The Contractor shall prove operability of the software by demonstrating that the software can be used R3***as described in the upgrades and enhancement NOCs***.

2.1.1 Milestones (Optional): None

2.1.2 Deliverables and Schedule (Required):

1. CDs containing the software and associated documentation: R3***As noted in NOCs***

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the R3***NOC*** deliverables, with reasonable quality, within the contracted cost by the contracted date.

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost
- Delivery of error-free code with documentation describing the functionality of the code, the scope of its operation, and internal/external software and/or hardware dependencies.

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- R3***Delivering instructive "User's Guide" documentation for software routines requiring user interaction (such as software modules with a Graphical User Interface for data input and manipulation).***
- Provide R3***NOC*** deliverables to the government at least one month ahead of schedule.

2.2 Subask 2: (NOC) The Contractor shall deploy and utilize ViDI / LiveView3D to acquire and visualize aerodynamic data during wind tunnel tests at NASA LaRC. A minimum of R1~~three~~ R2~~five~~ ten tests R3***per year*** conducted in LaRC wind tunnel facilities are to be performed under this subtask. The typical duration for each wind tunnel entry is two weeks of active testing. Each test will require approximately two weeks of pre-test preparation and three weeks of post-test analysis and documentation. This subtask covers testing activities that will occur from [R2]January 25, 2007 through [R3]~~December 31, 2008~~ ***December 31, 2009***. Support of each test includes (a) participation in all pre-test meetings, (b) pre-test configuration of the LiveView3D system hardware, software, and configuration files to meet test objectives, (c) running LiveView3D during each test, (d) data archival, (e) documentation and preparation of deliverable package, (f) delivery of deliverable to customer.

2.2.1 Milestones (Optional): None

2.2.2 Deliverables and Schedule:

For each test, the Contractor shall provide:

1. CDs/DVDs containing the archived data, ViDI/LiveView3D rendered images and animations, and documentation describing the test, utilization of ViDI / LiveView3D, results, and conclusions / observations.
2. All documentation intended for delivery to the customer as a deliverable is to be of professional quality suitable for publication as a NASA Contractor Report.
3. Deliverables are to be provided within 30 calendar days of the completion of the wind tunnel test.

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.
- Quality of documentation provided as deliverable – must be professional quality suitable for publication as a NASA Contractor Report.

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Providing formal or informal training on the use of ViDI / LiveView3D to other contractor or civil servant personnel during the course of wind tunnel tests;
- Utilizing ViDI / LiveView3D for more than three test entries;
- Publishing (as author or co-author) test results obtained using ViDI / LiveView3D as a professional conference or journal publication.

2.3 Subtask 3: (NOC) The Contractor shall utilize ViDI technology to enhance the use of advanced instrumentation systems in NASA aerospace testing facilities. In this context, the Contractor shall use ViDI to (a) simulate the deployment of advanced instrumentation systems in aerospace testing facilities, thus aiding in instrument design, and (b) display data collected from advanced instrumentation systems gathered during tests. This subtask covers instrument development and aerospace testing activities that will occur between [R2]January 25, 2007 through [R3]~~December 31, 2008~~ ***December 31, 2009***. The Contractor shall use ViDI technology to assist in the design / deployment of advanced instrumentation systems in at least R1~~three~~ R2~~five~~ ten tests R3***per year***. The Contractor shall use ViDI technology to visualize data and results obtained from instrumentation systems in at least R1~~three~~ R2~~five~~ ten tests R3***per year***.

2.3.1 Milestones (optional): None

2.3.2 Deliverables and Schedule:

For each test, the Contractor shall provide CDs / DVDs containing:

1. ViDI-rendered images showing instrumentation system layout, optical paths, and simulated fields-of-view of instrumentation cameras. Instrumentation systems are to be simulated in the facility in which they are intended to be used. Instrumentation system layouts are to be simulated to accuracies better than ±0.5 inch.
2. ViDI-rendered images and animations of data and results acquired by advanced instrumentation systems during wind tunnel tests.
3. Documentation describing the instrumentation system layouts and post-test analyzed results.
4. All documentation intended for delivery to the customer as a deliverable is to be of professional quality suitable for publication as a NASA Contractor Report.
5. Deliverables are to be provided within 30 calendar days of the completion of the wind tunnel test.

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date;
- Accuracy of the predicted instrumentation system optical paths and fields-of-view, relative to the ±0.5 inch requirement;
- Number of post-test results sets visualized using ViDI.

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Providing formal or informal training on the use of ViDI to other contractor or civil servant personnel for instrumentation system design and post-test data visualization;
- Utilizing ViDI to assist in instrument design and post-test data visualization for more than three testing activities;
- Publishing (as author or co-author) instrumentation system designs or experimental results visualized using ViDI as a professional conference or journal publication.

2.4 Subask 4: R3 ***(Complete)*** The Contractor shall transfer the Virtual Diagnostics Interface technology and LiveView3D software to NASA Glenn Research Center (GRC).

2.5 Subtask 5: R3 ***(Complete)*** The Contractor shall demonstrate near real time visualization of Planar Laser Induced Fluorescence (PLIF) imagery in the LiveView3D environment.

Begin R2 block addition

2.6 Subtask 6: R3 ***(Complete)*** The Contractor shall utilize ViDI to simulate the field-of-view and resolution of at least four different imaging systems proposed for in-flight imaging of the HTV-2 vehicle within the Air Force Falcon program.

End R2 block addition

Begin R3 block addition

2.7 Subtask 7: (NOC) The Contractor shall provide ViDI support to the Advanced Sensing and Optical Measurement Branch (ASOMB) for the design, development, and implementation of advanced instrumentation systems in aerospace test facilities. This includes simulating pre-existing or new instrumentation systems under development by ASOMB members, the installation of those systems in aerospace test facilities, analysis and visualization of data produced by instrumentation systems, and ViDI renderings and animations for use by ASOMB members in technical publications and presentations. The Contractor shall provide on-site (at LaRC) training to ASOMB members and collaborating partners from other LaRC organizations, including additional contract staff assigned to this task order, in the use of ViDI for instrumentation development and data analysis and visualization. The Contractor shall develop and deliver technical presentations and/or documentation to potential customers of the ViDI technology to describe ViDI capabilities. The Contractor shall attend and participate in meetings with customers interested in using ViDI technology for the purposes of describing the technical capabilities of ViDI. The contractor shall author / co-author professional conference papers for the purposes of communicating the technical capabilities of ViDI to the scientific community. The Contractor shall attend and participate in technical reviews and conferences to deliver conference papers and presentations on ViDI for the purposes of communicating the technical capabilities of ViDI to the scientific community. Notices of clarification to this subtask will be provided to define specific work elements as they develop. This subtask covers ViDI support for ASOMB to be performed from March 1, 2008 through December 31, 2009. It is estimated that 2000 hours of ViDI support for ASOMB will be required during this period of performance.

Travel

The following travel is anticipated for this subtask:

- Travel for one person for one two day trip to ATK-GASL in Ronkonkomo, NY to participate in technical meeting, April, 2008.
- Travel for one person for one three-day trip to participate in technical meeting, NASA Ames Research Center, Moffett Field, California, June, 2008
- Travel for one person for one three-day trip to participate in technical meeting, NASA Johnson Space Center, Houston, TX, November, 2008

- Travel for two people for 5 days to participate in AIAA Aerospace Sciences Meeting, Orlando, FL, January, 2009
- Travel for one person for one three-day trip to participate in technical meeting, NASA Ames Research Center, Moffett Field, California, June, 2009
- Travel for one person for one three-day trip to participate in technical meeting, NASA Johnson Space Center, Houston, TX, November, 2009

Travel destinations and dates may change based on actual meeting locations and dates.

DELIVERABLES	DATE
1. Functional ViDI models, renderings, and animations of ASOMB-developed instrumentation systems installed in aerospace testing facilities for the purposes of instrumentation development.	No later than 30 calendar days after receipt of instrumentation parameters from NASA.
2. Post-test ViDI renderings and animations of measurement data generated by ASOMB members, suitable for professional publication / presentation.	No later than 30 calendar days after receipt of data from NASA.
3. Documentation consisting of technical presentations and conference publications (or portions thereof) intended for communicating the technical capabilities of ViDI to the scientific community.	Final drafts of all original material that will be publicly released must be entered into the NASA LaRC LF99 system no later than 14 days prior to the conference / meeting submittal deadline.

Subtask 7 Performance Metrics/Standard (Required - Meets, Exceeds):

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date;
- Functionality, suitability, and clarity of ViDI models, renderings, and animations.

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Providing deliverables 2 weeks earlier than due dates
- Customer response that indicates greater than anticipated functionality, suitability, and clarity
- Error-free documentation earlier than due dates

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

2.n Subtask n - Working Environment Safety and Organization

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:

Office and laboratory space will be provided in NASA LaRC Building 1200. Desk/work areas with PC-compatible desktop computers, printers, and necessary software and supplies will be provided. All other computing software and hardware required for developing and deploying ViDI / LiveView3D in government facilities will be provided by the government. R3***However, it is anticipated that small purchases of some material and software may be necessary to efficiently address the technical requirements of this task order.***

4. Other Essential Information:

- Contractor personnel working on this task must be certified in the safe use of lasers.
- All software, including source code, libraries, executable code, and scripts, are to be provided to the government for unrestricted use and duplication.
- Travel: Travel to participate in two scientific conferences (California) is anticipated during the performance period. R1Also see Subtask 4.

5. Security Clearance:

- Contractor personnel working on this task must maintain a "SECRET" security clearance.

Begin R2 block addition

The Contractor will require access to data and information deemed "Government Purpose Rights Information" for successful completion of this task. The Contractor must sign an Individual ATK Employee Non-Disclosure Agreement with NASA to gain access to this information. Additionally, the Contractor will require access to data and information deemed "Lockheed Martin proprietary" for successful completion of this task. The Contractor must sign a Non-Disclosure Agreement (NDA) with Lockheed Martin to gain access to this information.

End R2 block addition

6. Period of Performance:

Planned start date: R2 January 25, 2007 Completion date: R2 ~~November 30, 2007~~ R3 ~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Gary Fleming
M/S: 493 Phone: 864 - 6664

Other POC (Optional): Kenneth Wright
M/S: 493 Phone: 864 - 4665

TASK ORDER NUMBER: 024D3-NNL07AM34T Revision: 2 Change: 0 Date: June 9, 2008

Title: **Development of Particle-Based Flow Diagnostic Techniques**

1. Purpose, Objective, or Background (Optional) (This subtask continues enduring work performed under SAMS Task 01D3D.)

The objective of this Task Order is to provide support for the research and development of [R2]***laser based*** diagnostic techniques and instrumentation systems. This includes technologies such as [R2>]***Laser Induced Thermal Acoustics,***[<R2] Doppler Global Velocimetry, point-Doppler Velocimetry, and other derivative methods. These techniques are being developed within the Advanced Sensing and Optical Measurement Branch (ASOMB) at NASA Langley Research Center. The technical scope of the task is broad, encompassing activities such as computer programming, electronics design and fabrication, signal and image processing, data and image acquisition, lasers, optics, and instrumentation science. Funding for this task comes predominantly from the NASA Fundamental Aeronautics Program.

Revision 1 (7/11/07): Extends the schedules of Subtasks 1, 3 and 4; extends the overall task order period of performance 13 months to December 31, 2008; incorporates the NOC feature applicable to new Subtask 5; re-designates safety and organization subtask as "2.n"; and updates the initial task order start date to January 25, 2007 (see [R2] below).

Revision 2 (6/9/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support, adds requirements as new Subtask 6, adds various updates and clarifications, and documents the change from Other POC to Technical Monitor (see [R2] above and below).

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

Begin [R1] block addition

Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) applies to this task order. The Contractor shall provide support for the research and development of [R2]***laser based*** diagnostic techniques and instrumentation systems. This effort includes technologies such as [R2>]***Laser Induced Thermal Acoustics,***[<R2] Doppler Global Velocimetry, point-Doppler Velocimetry, and other derivative methods. These techniques are being developed within the Advanced Sensing and Optical Measurement Branch (ASOMB) at NASA Langley Research Center. The technical scope of the task order is broad, encompassing activities such as computer programming, electronics design and fabrication, signal and image processing, data and image acquisition, lasers, optics, and instrumentation science. Funding for this task order comes predominantly from the NASA Fundamental Aeronautics Program. The NASA requirement for this work is expected to endure through [R2]***12/31/09***. Notices of Clarification (NOC) will be provided to define the NASA requirements and funding sources as the work is requested by NASA programs and/or reimbursable customers. See NOC designated item(s) and description below.

End [R1] block addition

2.1 Subtask 1: The Contractor shall [R2>]***assist in software and hardware development associated with the development of Laser Induced Thermal Acoustics (LITA) systems in ASOMB labs and LaRC ground test facilities.***[<R2]

- The Contractor shall [R2>]***work with researchers to identify software requirements for user interfaces, acquisition, and analysis of data from LITA systems.***[<R2]
- The Contractor shall [R2>]***develop interfaces and other software for LITA systems and***[<R2] document the results.
- The product of this subtask shall be a thorough, professional report documenting the [R2]***LITA*** system

performance for measuring R2>***flow field parameters.***<R2 This report shall include: (a) analyses of experimental data R2>***to quantify measurement accuracy***<R2, resolution, and precision; (b) a thorough description of the test setup and operating conditions. The report shall address the primary sources of R2***LITA*** measurement error and the suggestions on ways to minimize the errors in future testing.

2.1.1 Milestones (Optional): None.

2.1.2 Deliverables and Schedule (Required):

1. Report, in both hardcopy and electronic formats. Due no later than R1~~November 30, 2007~~ R2~~June 30,2008~~ ***August 31, 2009***

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.
- Quality of documentation provided as deliverable – must be professional quality suitable for publication as a NASA Contractor Report.

Standards:
Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Publishing (as author or co-author) results as a professional conference or journal publication;
- Provide stated deliverables to the government at least one month ahead of schedule;
- Quantify the R2***LITA*** system measurement accuracy, resolution, precision.

2.2 Subask 2: The Contractor shall deploy a R2***LITA*** system in the R2>***Unitary Plan wind tunnel***<R2 and evaluate the system performance characteristics.

- Under this subtask, the Contractor shall participate in all pre-test meetings, install the measurement system data acquisition computers and electronics in R2***Unitary***, interface the data acquisition equipment with measurement hardware, and operate the data acquisition equipment during all phases of testing.
- The Contractor shall process and analyze the acquired data to produce flow angularity measurements

and determine the instrumentation system performance.

- The Contractor shall document the results in a professional quality document and provide this document as a deliverable.

2.2.1 Milestones (Optional): None

2.2.2 Deliverables and Schedule:

1. CDs/DVDs containing the archived raw and processed data, relevant photographs and drawings, and documentation of the results and conclusions / observations.
2. All documentation intended for delivery to the customer as a deliverable is to be of professional quality suitable for publication as a NASA Contractor Report.
3. Deliverables are to be provided within 120 calendar days of the completion of the wind tunnel test and no later than ~~November 30, 2007~~ R2 ***November 30, 2009.***

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.
- Quality of results and documentation provided as deliverable – must be professional quality suitable for publication as a NASA Contractor Report.

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Publishing (as author or co-author) results as a professional conference or journal publication;
- Delivering presentations to local LaRC groups (Supersonics customers, ASOMB members) describing the flow angularity measurement system, its performance characteristics, and measured results.

2.3 Subtask 3: The Contractor shall perform software development and testing of a high speed data acquisition system for LITA measurements.

- The software shall enable the use of government-owned data acquisition hardware for high speed LITA measurements.
- Software shall be written in LabView and C/C++ or other language as negotiated with ASOMB researchers.
- The software shall provide the user with a graphical user interface for controlling the data acquisition hardware and acquisition parameters.
- The software routines shall be fully documented. The documentation shall include version information, compiler information, lists of function prototypes, descriptions of the functionality of

each routine, software / hardware dependencies, known bugs / issues, and interface mechanisms.

2.3.1 Milestones (optional): None

2.3.2 Deliverables and Schedule:

1. CDs containing the software, including all source code, libraries, scripts, and executables.
2. Software documentation.
3. Deliverables for this subtask due no later than R1~~June 30, 2007~~ R2~~December 31, 2008~~ ***December 31, 2009***.

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date;

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost;
- Delivery of error-free code with documentation describing the functionality of the code, the scope of its operation, and internal/external software and/or hardware dependencies.

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Providing formal or informal training on the use of the data acquisition software to other Contractor or civil servant personnel;
- Developing a User's guide for the software.

2.4 Subtask 4: The Contractor shall develop data acquisition, processing, and analysis software for R2***LITA*** instrumentation and measurements.

- The Contractor shall identify areas of commonality between R2***LITA***, and related techniques, and develop "universal" libraries or code modules for achieving these common tasks.
- The Contractor shall develop additional "specific" libraries or code modules to achieve acquisition / processing / analysis tasks that are specific to R2***LITA***.
- Software shall be written in LabView and C/C++.
- The software routines shall be fully documented. The documentation shall include version information, compiler information, lists of function prototypes, descriptions of the functionality of each routine, software / hardware dependencies, known bugs / issues, and interface mechanisms.

2.4.1 Milestones (optional): None

2.4.2 Deliverables and Schedule:

1. CDs containing the software, including all source code, libraries, scripts, and executables.
2. Software documentation.

3. Deliverables for this subtask due no later than [R1]~~November 30, 2007~~ [R2]~~December 31, 2007~~ ***December 31, 2009***.

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

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

- Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date;

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost;
- Delivery of error-free code with documentation describing the functionality of the code, the scope of its operation, and internal/external software and/or hardware dependencies.

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Adding software modules to enable [R2]***LITA*** data to be stored in Hierarchial Data Format version 5 (HDF5) or the Common General Notation System (CGNS) that will streamline the importing of [R2]***LITA*** data into the Virtual Diagnostics Interface environment;
- Exploring, identifying, and documenting where the software may be utilized to support other instrumentation systems and techniques in the Advanced Sensing and Optical Measurement Branch.

Begin [R1] block addition

2.5 Subtask 5: The Contractor shall support the research, development, deployment, and use of optical instrumentation systems for NASA facilities. In this capacity, the Contractor shall develop the necessary support electronics, computer programs, cabling, and subsystems required to implement a variety of optical instrumentation systems in NASA wind tunnels and ground test facilities. The Contractor shall assist in the operation of the instrumentation systems, and perform data collection, archival, processing, analysis, and documentation. Electronic Notices of Clarification (NOC) will be issued to define the NASA requirements and funding sources for this subtask as the work is requested by NASA programs and / or reimbursable customers. ~~It is anticipated that up to 5 facility implementations will be required by December 31, 2008.~~

2.5.1 Milestones (optional): None

2.5.2 Deliverables and Schedule:

1. Support electronics with schematics – within180 days of receiving NOC
2. Software and documentation – within 180 days of receiving NOC
3. Cabling and subsystems – within 180 days of receiving NOC
4. Operational assistance to include data collection, archival, processing, analysis, and documentation – as established in NOC

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

Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost;
- Delivery of error-free code and system operation with documentation describing the functionality of the code, the scope of its operation, and internal/external software and/or hardware dependencies.

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

- Earlier than requested delivery
- Improvements to overall efficiency beyond the customers expectation

End R1 block addition

Begin R2 block addition

2.6 Subtask6: The Contractor shall support the research, development and use of an optical inertial measurement system. In this capacity the Contractor shall work with LaRC researchers to develop the necessary optical and electronic components and subsystems. In particular a next generation Intelligent Star sensor (point source reference) and inertial rate sensor. Combining the Star Sensor (reference point source) and Inertial sensor enables a sophisticated instrument capable of measuring platform jitter and high precision pointing and tracking. The Contractor shall assist in the optical, electronics, computer programming developments required for the instrument.

2.6.1 Milestones (optional) None

2.6.2 Deliverable and Schedule:

1. Documentation shall be provided for developed software and optical and electronic componentry.
2. Optical information and clean room procedures shall be provided to ensure experimental accuracy and reliability.
3. A CD ROM of all data generated with description of developed software and hardware shall be provided by 31 Dec 2009

2.6.3 Performance Metrics/Standard (Required-meets, exceeds):
Standards:

Minimum acceptable performance standards:

- Providing all deliverables for this subtask within the specified time and contracted cost;
- Delivery of error-free code and system operation with documentation describing the functionality of the code, the scope of its operation, and internal/external software and/or hardware dependencies.

Exceeds Minimum Standards: The Contractor can exceed minimum performance standards by either:

Earlier than requested delivery or

Improvements to overall efficiency beyond the customers expectation

End R2 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.

3. Government Furnished Items:

Office and laboratory space will be provided in NASA LaRC Building 1200. Desk/work areas with PC-compatible desktop computers, printers, and necessary software and supplies will be provided. All other computing software and hardware required for developing and deploying R2 ***LITA*** related hardware and software in government facilities will be provided by the government.

4. Other Essential Information:

- Contractor personnel working on this task must be certified in the safe use of lasers.
- All software, including source code, libraries, executable code, and scripts, are to be provided to the government for unrestricted use and duplication.
- Travel and participation of one contract personnel in two scientific conferences located in California is anticipated under this task.

5. Security Clearance:

- None Required

6. Period of Performance:

Planned start date: R1 January 25, 2007

Completion date: R1 ~~November 30, 2007~~
R2 ~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): R2 ***Kenneth Wright***

M/S: 493 Phone: 864 - ***4665***

Other POC (Optional): R2 ***None***

TASK ORDER NUMBER: 025D3 Revision: 1 Change: 0 Date: February 27, 2007

Title: **Development of Advanced Thermoelectric Material**

1. Purpose, Objective, or Background (Optional) (We currently are conducting this research under the SAMS contract NAS1-00135B, task order 05D3G, with STC and must retain the current staff member currently assigned.)

The purpose of this task is for the Contractor to conduct research for new materials and fabrication techniques for advanced thermoelectric (TE) device applications.

Advanced TE materials that offer a high figure of merit (FOM) greater than 4.0 are really needed for high efficiency device coolers and generators. There have been shortcomings in TE material development due largely to the fundamental material issues, such as the increase in electrical conductivity while reducing thermal conductivity of TE materials. Development of new and high FOM TE materials is, accordingly, hinged on new approaches away from conventional methods. Therefore, the proposed work is (1) to develop new design of TE materials, (2) to create new approaches for new TE material fabrication, and (3) to grow or fabricate new and advanced TE materials for high FOM.

Revision 1 (2/27/07): Shortens the period of performance nine months to March 31, 2007 due to NASA funding/programmatic constraints (see [R1] below, Section 6).

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

2.1 Fabrication Techniques Development: The Contractor shall develop new techniques for fabrication of advanced thermoelectric materials.

2.1.1 Milestones (Optional): NA

2.1.2 Deliverables and Schedule (Required): Fabrication technique(s) for advanced TE materials as developed with progress reported quarterly.

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

Meets: Technique describes process that can be duplicated.

Exceeds: Multiple duplicable or promising techniques or multiple duplicable or promising approaches to the same technique each quarter.

2.2 Thermoelectric Materials Development: The Contractor shall develop thermoelectric materials with advanced epitaxial technology.

2.2.1 Milestones (Optional): NA

2.2.2 Deliverables and Schedule (Required): TE materials produced with advanced epitaxial technology as developed with progress reported quarterly.

TASK ORDER NUMBER: 025D3 Revision: 1 Change: 0 Date: February 27, 2007

Title: **Development of Advanced Thermoelectric Material**

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

Meets: Description of new advanced TE material.

Exceeds: Demonstration of repeatability.

2.3 Requirement/subtask: The Contractor shall characterize the synthesized thermoelectric materials for electrical and thermal properties.

2.3.1 Milestones (Optional): NA

2.3.2 Deliverables and Schedule (Required): Electrical and thermal characterization data upon completion with progress reported quarterly.

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

Meets: Measured data that can be duplicated.

Exceeds: Demonstrate greater than 90% duplicability among samples.

2.4 Requirement/subtask: The Contractor shall prepare and submit quarterly and final reports.

2.4.1 Milestones (Optional): NA

2.4.2 Deliverables and Schedule (Required): Quarterly and Final Reports.

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

Meets: Reports descriptive of work performed

Exceeds: Complete status summaries as reportable results are achieved.

2.5 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.

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

2.5.2 Required date: Ongoing.

2.5.3 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:

Research shall be conducted on site at NASA LaRC throughout the period of performance. The Government will provide the following base support: Government-controlled working space, material and equipment.

TASK ORDER NUMBER: 025D3 Revision: 1 Change: 0 Date: February 27, 2007

Title: **Development of Advanced Thermoelectric Material**

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:

TRAVEL: Two trips shall be included, as necessary, for presenting research results at conferences or for collaborative efforts to advance the research being performed. The trips shall be within the United States, and be funded for one east coast and one west coast trip, each lasting the length of the conference/event including travel time. The Contractor shall coordinate travel with Technical Monitor well in advance for technical value, accurate task estimates, and adequate task funding.

5. Security Clearance:

A DD 254 is not required for this requirement.

6. Period of Performance:

Planned start date: January 2, 2007 Completion date: R1~~December 31, 2007~~ ***March 31, 2007***

7. NASA Task Management:

Technical Monitor (Required): Glen C. King

M/S: 188A Phone: (757) 864-4123

Other POC (Optional): Sang H. Choi

M/S: 188A Phone: (757) 864-1408

TASK ORDER NUMBER: 026D3-NNL07AM36T Revision: 2 Change: 0 Date: April 1, 2008

Title: **Airline, Corporate, General Aviation Technical Expertise and Test Subject Delivery**

1. Purpose, Objective, or Background (Optional): (CONTINUATION OF 10RDE, NAS1-00135B)

The Crew Systems and Aviation Operations Branch has an ongoing responsibility to conduct pilot performance studies of flight deck systems concepts for various projects. The purpose of this task is to provide airline, corporate, and general aviation (GA) technical perspectives and test subjects with experience in national airspace system (NAS) operations, specifically (but not limited to) airline, corporate and GA operations; air traffic control (ATC); dispatchers; and flight service stations (FSS) to participate in these activities. The subtasks are to be completed December 31, 2007.

Revision 1 (9/10/07): Extends the period of performance 12 months in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and documents the 3/13/07 Technical Monitor change (see [R1] below).

Revision 2 (4/1/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R2] below).

Technical Direction 1 (6/13/08): Adds clarification of other Center potential activity in Section 4 (see [TD1] below).

Technical Direction 2 (10/6/08): Adds an Alternate 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. (1) As each specific support requirement becomes defined, the Technical Monitor will provide clarification to the Contractor by means of a Support and Subject Request Form (SSRF). (2) The schedule sensitive nature of this task order is such that requirement cancellation or change subsequent to definition could result in incurred costs by the Contractor or NASA without contributing to the research objective(s). Therefore subsequent clarification(s) will be used to document requirement changes for items on SSRF(s).

The Contractor shall perform the following subtasks:

A. Subject Recruitment

1. Recruit willing participants for future experiments.
2. Administer to potential subjects recruited from Subtask A1 an *Applicant Background Questionnaire* provided by NASA.
3. Establish and maintain a web-based, secure, password-protected database of subjects who completed the *Applicant Background Questionnaire* administered in Subtask A2. Database must:
   a. Be searchable by any user.
   b. Allow pilot's to logon to update their own profiles, view/apply for current experiments, upload electronic logbooks; allow administrators to log on to modify user profiles, search, export data, and e-mail selected group of users.
   c. Have an automatic form generation method to expand survey forms automatically when new fields are added to the database
   d. Allow for easy addition of new database fields.
   e. Allow complex queries (multiple AND, OR, NOT type logic).
   f. Allow search results to be exported or to automatically generate an email list of matched names.
   g. Include search field for "local" or not VA, MD, NC, DC.

h. Contain fields to store past experiments subjects participated in, the dates of these, and PI contact information.

4. Automate a link between the web database and Excel and FileMaker to support the generation of custom forms. Data from the webserver should be downloadable and/or synchronized to Excel and FileMaker on an as needed basis.

Note: Because of privacy and personal services issues, the web accessed data available to NASA shall exclude information such as name, social security number, and other person-specific information that would enable NASA to easily identify the individual(s) possessing the background information needed for a particular experiment.

Deliverables for *A. Subject Recruitment*:

(1) The database developed in Subtask A3.
(2) The search engine developed in Subtask A3.

Schedule for *A. Subject Recruitment*:

(a) Subtasks A1–3 shall be started by Jan 31, 2007.
(b) Subtask A3a shall be completed by April 30, 2007.

Metrics and Standards for *A. Subject Recruitment*:

a. Methods of recruitment (*e.g.*, business cards printed with website link, trade publications, the web, FBO, companies, trade organizations, etc.)
   [Subtask A1]
   MEETS if 3 methods of recruitment are used.
   EXCEEDS if more than 3 methods of recruitment are used.
b. Number and types of potential participants who filled out the *Applicant Background Questionnaire*
   [Subtask A2]
   MEETS if types of potential participants include commercial airline pilots, corporate pilots, and GA pilots.
   EXCEEDS if applicant can complete the background questionnaire online.
c. Number of searchable fields, which shall include, as a minimum:, (1) age, (2) sex, (3) type of pilot, (4) years of piloting experience, (5) time in type, and (6) whether *Applicant Background Questionnaire* from online or not.
   [Subtask A4]
   MEETS if searchable fields are the 6 listed above.
   EXCEEDS if searchable fields are more than 12.
d. Method of accessing the database.
   [Subtask A4]
   MEETS if database is searchable by any user.
   EXCEEDS if database is searchable by any user without the need for purchasing specialized software and is accessible remotely.

B. Technical Expert Participation in Planning and Conducting Experiments (NOC)

1. Provide technical experts to participate in experiment planning. The specific requirements will be detailed in the NOC. It is anticipated that an average of 1 technical expert (not to exceed 3) per NOC and a total of 3 NOCs for the current period of performance will be submitted.
2. Provide technical experts to help conduct experiments. The specific requirements will be detailed in the NOC. It is anticipated that an average of 1 technical expert (not to exceed 2) per NOC and a total of 2 NOCs for the current period of performance will be submitted.
3. Coordinate and provide all transportation, lodging, meals, incidental costs, and fees for each expert supplied by Subtasks B1 and B2 when s/he participates at the behest of NASA Langley Research Center.
4. Coordinate and provide all the necessary paperwork for participants' on-site access.
5. Report to the Task Monitor the estimated cost of Subtask B3 items for each NOC submitted. This initial estimate can be a rough order of magnitude (ROM) and will be used for internal NASA customer initial cost sharing determination only.
6. Report to the Task Monitor the (1) specialty of the expert participating in a particular experiment, (2) dates s/he (they) will be at NASA Langley Research Center, and (3) principal investigator (PI) for each NOC submitted.
7. Report to the Task Monitor a refined estimated cost of Subtask B3 items for each NOC submitted as the experiment progresses. This estimate will be used for internal NASA customer final cost sharing determination only.
8. Report to the Task Monitor the final (actual) incurred cost of Subtask B3 items for each NOC submitted.

   The final (actual) costs will be used for internal NASA customer final cost sharing only.

Deliverables for *B. Technical Expert Participation:*

(1) Technical experts to participate in planning of experiments (Subtask B1).
(2) Technical experts to help conduct experiments (Subtask B2).
(3) Report of the estimated cost estimate for each NOC submitted (Subtask B5).
(4) Report of participant data for each NOC submitted (Subtask B6).
(5) Report of the refined cost estimate for each NOC submitted (Subtask B7).
(6) Report of the final (actual) incurred cost for each NOC submitted (Subtask B8).

Schedule for *B. Technical Expert Participation*:

(a) Subtasks B1–2 shall be delivered in the timeframe indicated in the NOC. It is anticipated that at least 3 weeks lead-time will be provided in each NOC.
(b) Subtask B5 shall be delivered within 2 weeks after the NOC is received by the Contractor.
(c) Subtask B6 shall be delivered within 1 week after a change within a week's timeframe.
(d) Subtask B7 shall be delivered within 4 weeks after the last technical expert leaves or after a 4-week break in utilizing a technical expert.
(e) Subtask B8 shall be delivered within 4 weeks after the last technical expert leaves or after a 4-week break in utilizing a technical expert.

Metrics and Standards for *B. Technical Expert Participation*:

a. Number of hours of experience.
[Subtasks B1 and B2]
MEETS if the technical expert has the experience requested in the NOC.
EXCEEDS if 80% of the technical experts have experience of 200 hours more than that requested in the NOC.

b. Time to deliver participants from the date requested in the NOC, which will be no less than 3 weeks.
[Subtasks B1 and B2]
MEETS if 70% of the participants are delivered at the time requested in the NOC.
EXCEEDS if 90% of the participants are delivered at the time requested in the NOC.

c. Delivery time of anticipated incurred cost estimate.
[Subtask B5]
MEETS if report is received 2 weeks after the NOC is received by the Contractor.
EXCEEDS if report is received less than 2 weeks after the NOC is received by the Contractor.

d. Delivery time of participants data report.
[Subtask B6]
MEETS if report is received 1 week after a change within a week's timeframe.
EXCEEDS if report is received less than week after a change within a week's timeframe.

e. Delivery time of incurred cost report.
[Subtask B6]
MEETS if report is received 4 weeks after the last technical expert leaves or after a 4-week break in utilizing a technical expert.
EXCEEDS if report is received 2 weeks after the last technical expert leaves or after a 2-week break in utilizing a technical expert.

f. Delivery time of actual (final) cost incurred report.
[Subtask B8]
MEETS if report is received 4 weeks after the last technical expert leaves or after a 4-week break in utilizing a technical expert.
EXCEEDS if report is received 2 weeks after the last technical expert leaves or after a 2-week break in utilizing a technical expert.

C. Test Subjects (NOC)

1. Provide test subjects. The specific requirements will be detailed in the NOC, but is anticipated that an average of 8 subjects not to exceed 40 per NOC and 15 NOCs for the current period of performance will be submitted.
2. Coordinate and provide all transportation, lodging, meals, incidental costs, and fees for each subject supplied by Subtask C1 when s/he participates at the behest of NASA Langley Research Center.
3. Coordinate and provide all the necessary paperwork for subjects' on-site access.
4. Deliver subjects at the time and place requested in the NOC.
5. Report to the Task Monitor the estimated cost of Subtask C2 items for each NOC submitted. This initial estimate can be a rough order of magnitude (ROM) and will be used for internal NASA customer initial cost sharing determination only.

6. Report to the Task Monitor the subject schedule for each NOC submitted.
7. Report to the Task Monitor a refined estimated cost of Subtask C2 items for each NOC submitted. This estimate will be used for internal NASA customer final cost sharing determination only.
8. Report to the Task Monitor the final (actual) incurred cost of Subtask C2 items for each NOC submitted. The final (actual) costs will be used for internal NASA customer final cost sharing only.

Deliverables for Test Subjects NOC:
(1) Subjects for experiments (Subtask C1).
(2) Report of the estimated cost for each NOC submitted (Subtask C5).
(3) Report of the subject schedule for each NOC submitted (Subtask C6).
(4) Report of the refined estimated cost for each NOC submitted (Subtask C7).
(5) Report of the final (actual) incurred cost for each NOC submitted (Subtask C8).

Schedule for *C. Test Subjects*:
(a) Subtasks C1 and C4 shall be delivered in the timeframe indicated in the NOC. It is anticipated that at least three weeks lead-time will be provided in each NOC.
(b) Subtask C5 shall be delivered 2 weeks after the NOC is received by the Contractor.
(c) Subtask C6 shall be delivered within 1 week after a change within a week's timeframe.
(d) Subtask C7 shall be delivered within 4 weeks after the last subject is delivered.
(e) Subtask C8 shall be delivered within 4 weeks after the last subject is delivered.

Metrics and Standards for *C. Test Subjects*:

a. Time to deliver first subject dated from time request was received by Contractor.
[Subtask C1]
MEETS if within 3–4 weeks.
EXCEEDS if less than 3 weeks.

b. Scheduling of subjects.
[Subtask C1]
MEETS if 70% of the subjects used for an experiment are scheduled within NOCmal business hours (8:00 am to 5:00 pm) or the hours specified in the NOC.
EXCEEDS if 90% of the subjects used for an experiment are scheduled within NOCmal business hours (8:00 am to 5:00 pm) or the hours specified in the NOC.

c. Delivery time of subjects.
[Subtask C4]
MEETS if 70% of the subjects used for an experiment are delivered within 20 minutes of the scheduled time and to the correct location.
EXCEEDS if 90% of the subjects used for an experiment are delivered within 20 minutes of the scheduled time and to the correct location.

d. Delivery time of anticipated cost estimate.
[Subtask C5]
MEETS if report is received 2 weeks after the NOC is received by the Contractor.
EXCEEDS if report is received less than 2 weeks after the NOC is received by the Contractor.

e. Delivery time of subjects' data report.

[Subtask C6]
MEETS if updates are reported 1 week after a schedule change within a week's timeframe.
EXCEEDS if updates are reported less than 1 week after a schedule change within a week's timeframe.

f. Delivery time of incurred cost report.
[Subtask C7]
MEETS if report is received 4 weeks after the last subject is delivered or after a 4-week break in subject delivery.
EXCEEDS if report is received 2 weeks after the last subject is delivered or after a 2-week break in subject delivery.

g. Delivery time of final (actual) incurred cost report.
[Subtask C8]
MEETS if report is received 2 weeks after Contractor has received all related voucher and billing information.
EXCEEDS if report is received 4 days after the Contractor has received all related voucher and billing information.

D. 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***.<R2

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

(2) Required date: Ongoing.

(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. Applicant Background Questionnaire.
2. Notice of Clarification (NOC), Support and Subject Request Form.
3. Server to maintain database generated in Subtask A3.

4. Other Essential Information:

TD1>As noted in the contract PWS, Section J, Exhibit A, Scope, item 2(d): "Tasks will encompass the broad scope of LaRC mission responsibilities…and may include cooperative activities with other contractors, centers, and agencies."<TD1

5. Security Clearance: All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines.

6. Period of Performance:

Planned start date: R1 January 25, 2007

Completion date: R1 ~~December 31, 2007~~
R2 ~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): [R1]**Anthony M. Busquets**

M/S: 156A Phone: 757-864-6652

Alternate Technical Monitor: [TD2]**Jennifer L. Frost**

M/S: 156A Phone: 757-864-9950

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 027D3-NNL07AM37T Revision: 4 Change: 0 Date: July 7, 2008

Title: **Acoustic Facility Operations**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 20RBE)
The purpose is to provide experimental and analytical support to Airframe Noise and acoustic flight and wind tunnel research being performed by the Aeroacoustics Branch including research conducted in the Jet Noise Laboratory (JNL). The support may include the acquisition and reduction of aeroacoustic test data such as particle image velocimetry (PIV) and acoustic measurements on wing/flap and landing gear models; data analysis, software development and validation studies, data system integration, both for near real time and post-test scenarios with technology focus on rotors, jets, and other sound-producing devices in flight; and wind tunnel acoustic data acquisition system upgrades and enhancement for reliability and capability including enhancement of data archival and sampling capability.

Two test chambers reside in the JNL: the Low Speed Aeroacoustics Wind Tunnel (LSAWT) and the Small Anechoic Jet Facility (SAJF). For the JNL the Contractor is to provide electrical electrical, system administration, programming, and instrumentation support for JNL research programs.

Revision 1 (2/2/07): Adds requirements as new subtasks 10-14 (see [R1] below).
Revision 2 (8/13/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support and updates/clarifies Subtasks 1-8 and 11-13 schedules and requirements for the new period of performance (see [R2] below).
Technical Direction 1 (10/09/07): clarifies safety and organization Subtask 2.n and corrects the completion date in Section 6 (see [TD1] below).
Technical Direction 2 (11/20/07): completes the general description of the electrical engineering support in Subtask 8.4 by splitting the work between the Jet Noise Laboratory and the Liner Technology Facility without requiring any additional support (see [TD2] below).
Revision 3 (5/7/08): Adds/updates requirements with clarifications and updates POC data (see [R3] below).
Revision 4 (7/7/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support, with updated schedule for ongoing work, additional Subtask 16, and updated Subtask 4 (see [R4] below).
Technical Direction 3 (1/9/09): Changes POC on Subtasks 6 and 7 to Florence Hutcheson and reprioritizes work to enable Subtask 10 to continue through December 31, 2009 with no anticipated increase in overall staffing requirements (see [TD3] 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 specific support requirements become defined, clarification will be provided to the Contractor. See NOC designated item(s) and description below. Monthly technical and financial reporting is required at the subtask level. Monthly financial reports at the subtask level will be used only for cost sharing and/or cost accrual determination within the user organization.

Subtask 1. (NOC) Data Acquisition, Reduction, and Post Analysis
Thomas F. Brooks M/S: 461 Phone: 757-864-3634
The Contractor shall perform the acquisition, reduction, and post analysis of acoustic, PIV, and other related measurement data. The acoustic data are taken from the 33-microphone Small Aperture Directional Array (SADA) or the 41-microphone Array (MADA). Several acoustic tests are anticipated: [R2]Tandem Cylinder study, airfoil/turbulence interaction study and the gear/flap interaction test. The Contractor shall organize and document tests, equipment, and facilities.

The Contractor requirements shall include the following:

a) Set up equipment and perform post-test tear-down for each test configuration as required. Software shall be developed as needed for configuration control, data acquisition, and data processing.
b) Calibrate instrumentation as needed.
c) Acquire test data, per NASA-provided test plan.
d) Process data for both archiving and for near real-time presentation.
e) Perform backups of all data on DVD.
f) Post-process data at appropriate test breaks.

Performance Metrics/Standards: (See "System and Software Metrics for Performance-Based Contracting")

Meets:

a. Document validations that all data acquisition, processing, and backup systems function in manner determined by NASA on the Web based AeroCompass.
b. Show that acquisition can be accomplished, and properly stored, for each point.
c. Results of limited time-critical processing should be completed and displayed in short time.
d. Present processed data that verify correctness and completeness of the data on a daily basis.

Exceeds: The ability to provide data analysis throughout the test and in formats other than described herein to enhance physical understanding will be used to assess the level of performance exceeding the acceptable level.

Deliverables: Processed data in stored medium and in the form of charts and lists. All data fully documented with configuration, test conditions, and instrument settings defined. Present selected data in formats of publication quality. Organize and document existing data regarding the following tests:

1- Rods and Bars PIV and hot wire tests
2- Grid turbulence PIV test
3- Grid turbulence Hot Wire test
4- Landing gear PIV test
5- [R2]Tandem Cylinder study
6- lifting surface turbulence interaction test
7- [R2]gear/flap interaction test

Store organized information and documentation onto AeroCompass.

Schedule: Ongoing. The date for completion of this subtask shall be December 31, [R4]*2009* for tests performed to that date. Additional testing and extension(s) are anticipated beyond the task completion date.

Subtask 2. (NOC) Flight and Wind Tunnel Post-Test Data Processing Analysis and Reporting
David A. Conner M/S: 461 Phone: 757-864-5276

The Contractor shall perform post-test data processing analysis and reporting of data acquired during experimental tests(flight and wind tunnel) conducted by Aeroacoustics Branch personnel. The Contractor shall process data that were not processed during on-site analysis and that were not processed under prior task orders, as well as perform EDAS (Electronic Data Access System) [R2]or equivalent processing and additional analyses as clarified in NOCs It is anticipated that post-test data analyses will be required for no more than eight different experimental tests during the period of performance of this subtask.

Performance Metrics/Standards:
Meets: Perform specified analyses and computation of Sound Exposure Level (SEL), EPNL PNLT, SPL, BVISPL, ... and computation of areas inside various SEL levels, selected narrowband spectra or ensemble-averaged spectral time history, generation of Rotorcraft Noise Model (RNM) noise hemispheres, for identified test conditions. Minimum acceptable percentage of identified data runs processed in this manner is 95 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process. For the remainder of runs, identification and documentation of the reasons why these cases cannot be processed shall be provided.
Exceeds: Greater percentage of processed and EDAS archived data runs, as well as additional noise metrics computed and processing of ancillary data sets, will be used to assess the level of performance exceeding the acceptable level.

Deliverable: Specified noise data/metrics identified for each test in both graphic and digital formats, as required, within EDAS. Noise hemispheres in RNM required format. Post-processed data archived on both optical disk and/or tape media. Written description of data reduction and analysis procedures and results.

Schedule: Ongoing. Subtask 2 shall be completed by December 31, [R4]***2009***.

Subtask 3. (NOC) Programming and Consultation Support
David A. Conner M/S: 461 Phone: 757-864-5276
The Contractor shall provide programming and consultation support for modifications of and upgrades to the Digital Acoustic Measurement System (DAMS), the Wireless Acoustic Measurement System (WAMS), the Electronic Data Access System (EDAS) [R2]or equivalent, Rotorcraft Noise Model (RNM), [R2]I Can Hear It Now (ICHIN) and the Acoustic Detection of Aircraft Model (ADAM) to include: (1) software development including verification and validation; (2) data analysis; and (3) system analysis. It is anticipated that several upgrades/modifications will be required as a continuous process to miniaturize and maintain state-of-the-art systems. Key to this effort will be programming and consultation support for improvements in acoustic propagation prediction methods to include curved ray and parabolic equation methods.

Performance Metrics/Standards:
Meets: Upgrades and modifications successfully integrated into the DAMS, WAMS, EDAS, RNM, [R2]ICHIN and ADAM systems.
Exceeds: Additional features incorporated in the systems will be used to assess the level of performance exceeding the acceptable level.

Deliverable: Provide documentation of all programming and consultation support.

Schedule: Ongoing. Subtask 3 shall be completed by December 31, [R4]***2009***.

*****Begin [R4] block update*****

Subtask 4. (NOC) Low Noise Operations Research in Short Duration Flight Tests.

David A. Conner M/S 461 Phone: 8757-864-5276

The Contractor shall perform on-site data reduction and analysis of acoustic, weather, and aircraft position data acquired during acoustic flight tests to be conducted at locations selected by NASA. The test durations will vary and could be impacted by external influences such as weather and aircraft mechanical problems.

a. The Contractor shall process data received from NASA digital data recording systems. A typical data flight duration can vary from 90 seconds to several minutes depending on type of flight condition. Data from 20 to 28 microphone locations may be acquired for each flight condition. The maximum number of data acquisition hours in one day can vary from one to four hours with total test periods somewhat longer.

b. The Contractor shall also pack data processing equipment prior to shipment by NASA, perform pretest setup and post-test teardown of that equipment, and pack up the equipment prior to departing from the test site.

c. The approximate schedule of tests is as follows:

   1. [R2]Eglin AFB, Florida. The test is scheduled for [R2]August 2007 and is expected to last [R2]about four weeks. (Completed)
   2. Edwards AFB / Dryden, in California. Ikhana UAV test is scheduled for Fall 2008 and is expected to last approximately two weeks.
   3. Similar test (specific location and schedule TBD) for CY09

Performance Metrics/Standards:

Metric: Perform data quality assessment by analyzing overall relative sound pressure levels. Analyze ambient levels at test site and compare with ambient levels measured at other test sites. Minimum acceptable percentage of data runs processed in this timeframe is 80 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process. Greater percentage of processed data runs, as well as weather, aircraft state, and tracking data made available in this timeframe will be used to assess the level of performance exceeding the acceptable level.

Deliverables:

1. dBA and SEL data in both graphic and table formats. Raw and processed test data archived on DVD and 8mm tape. (Complete)
2. Data quality assessments in graphic format. Raw and processed test data archived on DVD.
3. TBD

Schedule: Subtask 4 to begin early April 2007 with a completion date of [R4R2]~~September 30, 2007~~ ***December 31, 2009***.

*****End [R4] block update*****

Subtask 5. Community Noise Flight Test.

David A. Conner M/S: 461 Phone: 757-864-5276

The Contractor shall perform on-site data reduction and analysis of acoustic, weather, and aircraft position data acquired during acoustic flight test to be conducted at China Lake, California. The test is scheduled for November 2006 and is expected to last three to four weeks. The test duration could be impacted by external influences such as weather and aircraft mechanical problems.

a. The Contractor shall process data received from the NASA digital data recording systems. A typical data flight condition lasts approximately 3-5 minutes depending on type of flight condition. Data from up to 12 microphone locations may be acquired for each flight condition. The maximum number of data acquisition hours in one day should not exceed four.
b. The Contractor shall also pack data processing equipment prior to shipment by NASA, perform pretest setup and post-test teardown of that equipment, and pack up the equipment prior to departing from the test site.

Performance Metrics/Standards:
Meets: Computation of Sound Exposure Levels (SELs) and dBA levels for each flight condition shall be computed post-flight, to be available in graphic format to all parties within 24 hours of receipt of the data. Minimum acceptable percentage of data runs processed in this timeframe is 80 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process.
Exceeds: Greater percentage of processed data runs, as well as additional noise metrics, aircraft state and tracking data made available in this timeframe will be used to assess the level of performance exceeding the acceptable level.

Deliverables: dBA and SEL data in both graphic and table formats. Raw and processed test data archived 8mm tape and DVD.

Schedule: [R2]Completed July 28, 2007.

Subtask 6. (NOC) On-site Data Reduction and Preliminary and Post Analysis

TD3> ***Florence Hutcheson M/S: 463 Phone: 757-864-1054*** <TD3

The Contractor shall perform on-site data reduction and preliminary and post analysis of particle image velocimetry (PIV) images and resulting vector maps, acoustic data, surface pressure data, hot wire flow measurements, and other related measurement data. Software shall be developed or modified, as required, for data logging, archiving to stored media (DVD, CD) and processing. The PIV measurements are taken with Integrated Design Tools (IDT) software and are to be processed as well using this software. The hot wire data will be processed using Matlab and TSI software. The acoustic data are primarily taken from the 41-microphone Array (MADA) or the 33-microphone Array (SADA). The model(s) contains 100 or more Kulite pressure transducers. A total of 3 tests are anticipated. The Contractor requirements shall include the following:

a. Develop and maintain the software to archive data obtained in the QFF to DVD
b. Archive data as they are obtained during the following experimental efforts:
   Rods and Bars test, landing gear tests, CML tests, airfoil turbulence interaction study test, blown flap test. Process data from each of these tests as required.
c. Document all data archiving and processing procedures,
d. Show that the archived data locations can be determined using the searchable procedures on EDAS

and that the located data are on the specified DVD.

Performance Metrics/Standards:

Meets:

a. Documentation (written) of all data archiving procedures and processing, PIV and acoustic data processing.
b. Demonstration of searching and identifying data files and location using the database log file on EDAS.
c. The delivery of processed results provided according to the schedule specified.
d. Presentation of processed data that verify correctness and completeness of the data on a daily basis.

Exceeds: The ability to provide processed data throughout the test will be used to assess the level of performance exceeding the acceptable level.

Deliverables: Documentation is to be in the form of comments in the software and procedures, and as user guide reports. Data is to be in the form of electronic files cataloged on EDAS and reports.

Schedule: Ongoing. Subtask 6 shall be completed December 31, [R4]***2009***.

Subtask 7. Portable Data Acquisition System

TD3>***Florence Hutcheson M/S: 463 Phone: 757-864-1054***<TD3

7.1 The Contractor shall develop a portable data acquisition system (DAQ) from Government-provided hardware for the dual purposes of : (1) serving as an additional subsystem slaved to the existing DAQ in the Quiet Flow Facility, and (2) as a stand-alone system for rotor systems testing in LaRC wind tunnels and other testing facilities. The system shall meet the following specifications:

a. Computer-controlled through LabVIEW and/or other suitable programming languages.
b. Comprised of a signal conditioning subsystem with a capacity of 64 passband channels, each filter stage pre-and post-gained, and a 64-channel digitizing subsystem with external clock and trigger capabilities.
c. Have communication busses (ie, RS-232, IEE-488, and/or Ethernet connections) to allow integration with existing facility data systems which are usually part of the overall data throughput process required for testing.
d. Able to control a microphone traversing subsystem in the 14x22 Ft Subsonic Tunnel which has been mothballed for the last 8 years. A checkout of the traversing subsystem shall be accomplished by a partial traverse rail setup and operation in the 14x22 Ft Tunnel. This feature will require coordination with tunnel personnel and checkout of the support infrastructure (Z-drives, cabling to the control area and motor encoders, etc) for the traverse. [R2]Note: Stopped due to redesign of traverse system June 2007.
e. R2>Interface the DAQ system with the new traverse system being designed for the 14x22 Ft Subsonic Tunnel. The requirements for this new traverse are being defined by NASA and Rome will perform the design. The contractor will work with NASA to ensure the DAQ system will interface with the new traverse system.<R2

Hardware components and software: Most hardware items and vendor support software have been or are under the process of being acquired. Connection items such as traverse drive motors, DAQ front-end terminal blocks or BNC (Bayonet Neill Concelman) converters may need to be specified, acquired, and installed. Most activity on this subtask will be software development to achieve the above functionality.

7.2 The Contractor shall support of tests conducted in the QFF, 14x22 Ft Subsonic Tunnel, NFAC, or other testing facilities will also be required. This support shall include system setup/teardown, data acquisition and quick-look analysis, and data archiving.

Performance Metrics/Standards:

Meets: Specifications a. through d. above.

Exceeds:

a. Seamless integration in QFF and 14x22
b. Minimal (less than one hour) setup/teardown effort to migrate system from one facility to another

Deliverables: A portable DAQ with full-function software control of all devices. Support of acoustic tests in LaRC facilities.

Schedule: R2 Ongoing Subtask 7 shall be completed by December 31, R4 ***2009***.

Subtask 8. JNL Electrical Engineering, System Administration, Programming, and Instrumentation Support

R3> **William M. Humphreys M/S: 461 Phone: 757-864-460*1*** <R3

8.1 The Contractor shall develop a transition plan for converting the current LSAWT control system based on Paragon software to one that is widely used and supported by other facilities at NASA Langley Research Center.

The Contractor requirements shall include:

(a) Identifying LaRC standards for laboratory control systems;
(b) Selecting a control system for the LSAWT that is consistent with Center standards and used in other Center facilities;
(c) Developing a transition plan to convert the current control system to a control system proposed in (b).

Meets:

(a) Document center standards for control systems.
(b) Document criteria used to select the control system for LSAWT.
(c) Deliver control system transition plan.

Exceeds: Develop an implementation plan for the new LSAWT control system.

Deliverables: A written transition plan for a new LSAWT control system.

Schedule: The date for completion of this subtask shall be December 31, R4***2009***.

8.2 The Contractor shall provide system administration/computer support and perform data archival activities for the JNL.

The Contractor requirements shall include:

(a) Archiving research data on R2DVD and NASA LaRC Distributed Mass Storage System (DMSS);
(b) Performing system backups on JNL research and archival computers;
(c) Providing system administration/computer expertise to the JNL team;
(d) Acquiring research data during experiments conducted in the LSAWT.

Meets:

(a) Data is archived within 2 weeks of the completion date of a test.
(b) Computer system backups are performed weekly.
(c) Computer/administration expertise is provided within 2 days of receiving a request.
(d) Data is acquired when requested.

Exceeds: Implementation of new archiving procedures, hardware, or software that increases rapid access to archived data.

Deliverables: Archived data on R2DVD and on DMSS. System backups on hard drives.

Schedules: Ongoing. Task will be completed by December 31, R4***2009***.

8.3 The Contractor shall provide in-situ calibration support for the JNL.

The Contractor requirements shall include:

(a) Performing in-situ calibrations of transducers, transmitters, ESP systems, and microphones;
(b) Provide recommendations for in-situ calibration procedural improvements;

Meets:

(a) Calibrations are performed on the day the request is made for transducers, transmitters, and ESP systems. Calibrations of microphones are completed within one week of a request.
(b) New recommended practices are given to JNL team when calibration procedures are updated.

Exceeds: New procedures leading to improved data accuracy are developed.

Deliverables: Electronic calibration files for transducers, transmitters, ESP systems, and microphones.

Schedules: Ongoing. Task will be completed by December 31, R4***2009***.

8.4 The Contractor shall provide electrical engineering support for research activities in the Jet Noise Laboratory R3>~~TD2~~~~and the Liner Technology Facility~~.<R3

The Contractor requirements shall include:

(a) Providing support for the maintenance and selection of facility and research instrumentation;
(b) Providing support for the design and development of research control systems;

Meets:

(a) Support will be provided within one week of a request.
(b) Support will be provided within one week of a request.

Exceeds: Implementation plans for upgrades to facility instrumentation and research control systems will be developed.

Deliverables: Functioning facility and research instrumentation. Required research control systems.

Schedules: Ongoing. Task shall be completed by December 31, R4***2009***.

8.5 The Contractor shall serve as the Software Configuration Manager (SCM) for the JNL control and DAS software.

The Contractor requirements shall include:

(a) Maintaining documentation required by LMS-CP-5529 and LMS-CP-5528;
(b) Developing a method to limit access to the DAS and control software programming codes;
(c) Developing and implementing a plan to control and document software revisions.

Meets: An implemented and maintained Software Configuration Management plan.

Exceeds: A program that automatically tracks software revisions.

Deliverables: An implemented Software Configuration Management plan.

Schedules: Ongoing. Task shall be completed by December 31, R4***2009***.

Subtask 9. JNL Specialized Computer Programming
R3>**William M. Humphreys M/S: 461 Phone: 757-864-4601**<R3
The Contractor shall provide specialized laboratory computer programming expertise.

The Contractor requirements shall include:

(a) Upgrading the SAJF DAS as needed to meet new data acquisition requirements;
(b) Upgrading the LSAWT acoustic DAS modules as needed to meet new data acquisition requirements;
(c) Providing user and diagnostic manuals for the SAJF DAS.

Meets:

(a) DAS upgrades meet requirements for tests conducted in the SAJF;
(b) DAS upgrades meet requirements for test conducted in the LSAWT;
(c) Completed user and diagnostic manuals for the SAJF DAS.

Exceeds: New modules for the SAJF or LSAWT DAS programs that enhance DAS performance are developed.

Deliverables: Upgraded SAJF and LSAWT DAS programs. User and diagnostic manuals for the SAJF DAS systems.

Schedule: Task will be completed by December 31, 2007.

Begin [R1] block addition

Subtask 10: (NOC) Development of a Training System for SMA Actuators

Travis L. Turner M/S: 463 Phone: 757-864-3598.

The purpose of this subtask is to extend and/or alter the capabilities of the LabVIEW Virtual Instruments (VI) developed under closed Subtasks 10,11 and 19 (SAMS task order 13RBF) for data acquisition and control during tests of shape memory alloy (SMA) actuators and SMA hybrid composite structures. The Contractor shall provide continued programming support for researcher-generated modifications (NOCs) for the system developed under closed Subtask 10 and used in the Smart Structures Development Laboratory (SSDL) in Bldg 1208. The Contractor shall extend the system developed under closed SAMS contract task order 13RBF, subtask 11 to accommodate specific requirements and general user specifications associated with performing cyclic thermomechanical tests on SMA actuators in the Light Alloy Laboratory (LAL) of B1205. Also, the Contractor shall extend and/or alter an existing LabVIEW VI for personal computer (PC) control of Bruel and Kjaer (B&K) Nexus accelerometer and microphone signal conditioning units will be required.

NASA will convey general software design requirements for nominal extension of the VI functionality by one or more NOC(s).

(a) The Contractor shall extend the VI to allow data acquisition and control of thermomechanical cycling tests using a bench top MTS test machine in the LAL of B1205.

(b) The Contractor shall upgrade existing VIs that control the B&K Nexus accelerometer and microphone signal conditioning units to LabVIEW 7.0 and shall modify and/or integrate into existing control VIs as required.

Schedule: Start Date: February 26, 2007.
Completion Date: December 31, [TD3] ***2009***

Deliverables:
(a) Updated LabVIEW VI to interface and control the MTS test machine.
(b)Updated LabVIEW VI to perform automated thermomechanical cycling of SMA actuators.
(c)Revised User's manual(s) for the LabVIEW VIs.

Performance Evaluation Criteria: The minimum acceptable level will be the completion of the deliverables. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and depth of assessment.

Subtask 11: (NOC) Acoustic Liner Evaluation:

Michael G. Jones M/S: 463 Phone: 757-864-5272.

The Contractor shall acquire data required for analysis of acoustic liner configurations, and shall provide oversight for usage and maintenance of following acoustic liner research test rigs: Grazing Incidence Tube, [R2]Grazing Flow Impedance Tube, Normal Incidence Tube, Vertical Impedance Tube, Raylometer, and Curved Duct Test Rig.

Data will be required using the above itemized test rigs at the maximum requirements per month below:

- Flow resistance data: 10 data sets per month
- Grazing Incidence Tube [R2]or Grazing Flow Impedance Tube total/static pressure survey: 2 data sets per month
- Acoustic pressure data in liner acoustic test rigs: 10 data sets per month

Schedule: Approx. Start Date: January 19, 2007
Completion Date: December 31, [R4]***2009***.

Deliverables:
Documented data charts and annotated electronic data files within 2 weeks of receipt of NOC.

Performance Evaluation Criteria:
Acceptable performance on this task shall be the timely acquisition of data. The minimum acceptable level is response within two weeks for 80% of NOC's. A greater percentage of timely responses will be the basis used to assess the performance exceeding the acceptable level.

Subtask 12: Development and Implementation of Liner [R2]Technology Facility:

Michael G. Jones M/S: 463 Phone: 757-864-5272

With the consolidation of the Flow Impedance Test and Anechoic Noise Reduction Facilities from buildings 1287 and 1218 into the Liner [R2]Technology Facility in building 1247, many of the systems have been replaced and/or upgraded with new systems. In order to bring the new facility on-line in an orderly manner, the new systems must be made operational and validated in their operation. [R2]In addition, there is an occasional need for the Contractor to operate a crane in support of tests with the Curved Duct Test Rig.

- The Contractor shall provide design and material specifications, assembly and fabrication oversight, and software support for operation and upgrades of the Flow Impedance Test and Anechoic Noise Reduction Facilities. These upgrades include renovations incorporated into the merging of these two facilities into a new Liner R2Technology Facility.
- The Contractor shall conduct checkout tests (test plan to be supplied by the Government) to assess the acoustic test rigs when the Liner R2Technology Facility is brought online.
- The Contractor shall provide a User's Guide for the operation of these facilities that shall provide guidance and trouble-shooting procedures for autonomous operation of the acoustic test rigs by other operators.

Begin R2 block addition

- The Contractor procedures for lifting devices, equipment, and operations shall conform to LPR 1740.2 *Facility Safety Requirements,* NPR 8715.3 *NASA Safety Manual,* and NASA-STD-8719.9 *Standard for Lifting Devices and Equipment.*

End R2 block addition

Deliverables and Schedule: Approximate Start Date: January 19, 2007
R2Completion Date: December 31, R4***2009***

- Implementation of 47 (increase from current 31) microphones in each of the Curved Duct Test Rig upstream and downstream microphone arrays, to allow evaluation of higher-order modes. April 30, 2007.
- Status report documenting the development of the Liner Research Test Facility. May 30, 2007.
- User's Guide for Flow Impedance Test Facility and Anechoic Noise Reduction Facility (or Liner Research R2Technology, if implementation is completed). June 30, 2007.
- Implementation of 47 (increase from current 31) microphones in the Curved Duct Test Rig control microphone array, to allow control of higher-order modes. October 15, 2007 (contingent on NASA research schedule).
- Implementation of microphone array (up to 40 microphones) in Curved Duct Test Rig treated section to support impedance eduction capability. R3~~November 15, 2007~~ R4~~November 15, 2008~~ ***January 30, 2009*** (contingent on NASA research schedule).
- R3>User's Guide for Flow Impedance Test Facility and Anechoic Noise Reduction Facility (or Liner Technology Facility, if implementation is completed). June 30, 2008.<R3
- R2Consolidated User's Guide for Liner Technology Facility (if implementation is completed). R3>~~July 31, 2008~~ R4~~October 30, 2008~~ ***May 30, 2009*** (contingent on government schedule).<R3

Performance Evaluation Criteria

Progress toward completion of deliverables will be assessed on a monthly basis. The minimum acceptable level will be completion of deliverables by the required dates. Performance exceeding the acceptable level will be based on:

- Completion of the deliverables at least one month before the required dates.
- Implementation of significant facility enhancements beyond those included in Government-furnished guidelines.
- Development of software with capabilities significantly exceeding those included in Government-

furnished guidelines.

Subtask 13: Fundamental Liner Research:

Michael G. Jones M/S: 463 Phone: 757-864-5272

Initial studies of channel skew on locally reacting liners have been positive but not well understood. This task seeks to further study and exploit this effect on the performance and fabrication of realistic liner configurations. R2>Under the Fundamental Aeronautics Program, there is a need for increased understanding of the acoustic performance of foam liners, and their appropriate usage in multiple applications (e.g., rotorcraft cabin noise reduction, fan source noise reduction). A single point-of-contact for foam-related activities is needed. In addition, semi-empirical models for multiple types of foam liners (e.g., metallic and polyimide foams) are needed.<R2

- The Contractor shall conduct an investigation of the effects of channel skew on local-reacting liner impedance.
- The Contractor shall design test samples in conjunction with Government personnel, and shall provide oversight in the fabrication process.
- The Contractor shall conduct tests with the acoustic test rigs of the Flow Impedance Test Facility, and shall perform computations with Government-furnished prediction code(s). Measured and predicted results shall be compared to support enhancements to the Government-furnished prediction code(s).

Begin R2 block addition

- The Contractor shall design foam test samples in conjunction with Government personnel, and shall provide oversight in the fabrication process.
- The Contractor shall conduct tests on these foam samples, and use the results to develop semi-empirical prediction codes in conjunction with Government personnel.
- The Contractor shall work with Government personnel to become a single point-of-contact for foam-related liner research.

End R2 block addition

Schedule: Approx. Start Date: January 19, 2007
Completion Date: December 31, R4***2009***

Deliverables:

- Report documenting comparison of measured and predicted results, together with suggestions for enhancements to the Government-furnished prediction code(s). December 15, 2007.

Begin R3 block addition

- Report documenting design criteria and validity of prediction code for enhanced skewed resonator concept. R4~~August 30, 2008~~ ***September 30, 2008***.
- Report documenting comparison of semi-empirical model of one class of foam liners. September 15, 2008.

End R3 block addition

- R2Report documenting validation of semi-empirical model(s) of at least two classes of foam liners. R4~~December 15, 2008~~ ***February 28, 2009***.

Performance Evaluation Criteria

Progress toward completion of deliverables will be assessed on a monthly basis. The minimum acceptable level will be completion of deliverables by the required dates [R2]and response to all foam-related requests for information within two weeks. Performance exceeding the acceptable level will be based on completion of a report suitable for submission to an acoustics conference.

Subtask 14: (NOC) Thermal Acoustic Fatigue Apparatus (TAFA) Heater Controller

Mark W. Frye M/S: 463 Phone: 757-864-4102

Modifications are required to the TAFA Heater Controller to improve its safety, reliability, and functionality. The controller is a PC-based platform running a LabVIEW Virtual Instrument (VI) executable interfaced to a National Instruments SCXI front end. The controller receives temperature signals from the test article/facility, uses that information in a PID (proportional integral derivative) control algorithm, and outputs a single voltage signal (0-10 volts) to a series of SCR (silicon controlled rectifier) firing devices. The 10 SCRs produce the power required to a 10-zone 360 kW quartz heater array. The LabVIEW executable allows for the control, monitoring, data logging, and watch dogging of 32 type "K" thermocouples, 32 type "J" thermocouples, 8 flow meters, and 1 air pressure. Control can either be closed-loop, open-loop, or manual control.

- In phase I, the Contractor shall modify the existing VI. The requirements include:
  - Creation of a single "Master slider" to allow the user to set the level of any of the desired (up to 10) sliders. Allow individual sliders to be toggled to track with the master slider.
  - Modification to the Set Point Input (temperature) and Manual Control (voltage) windows to prevent inadvertent changes to the set points. Initially, maximum increments of 1 degree C/F to Set Point Input and 0.05 volt to Manual Control shall be implemented.
  - Modification of the PID control to prevent large scale changes in the output for every set point adjustment or screen refresh. The maximum increment shall be a user-defined variable set on the panel.
  - A provision to allow the user to save the configuration of the Set-up Screen and troubleshooting the voltage input configuration for the Lamp Bank Air Pressure Interlock.
- In phase II, the Contractor shall modify or rewrite the existing VI (as required). The requirements include:
  - Modification to allow test-specific, user-designated channel labels for presentation on the active display and in the output headers.
  - Modification to allow warning and/or limits to track with set point.
  - Modification of the controller to allow close-loop control to follow an arbitrarily specified temperature profile (within the limitations of the facility). Included in this modification is the option to hold and continue the progression of the profile in time.
  - Modification to allow for an additional (32) channels of type "K" thermocouples.
  - Modification to allow user-selected control parameters (flow meters rates, slider

positions, set points) to be logged.

- o Installation and configuration of a new DAQ board. The board will be provided as GFE.
- o All required code structure changes to enhance performance and efficiency following completion of the DAQ board upgrade.
- o An update to the user interface required for implementation of the above features.

- For both phases I and II, the Contractor shall perform a functional check prior to full acceptance by the facility. The check-out may require the use of the facility to provide the appropriate operational environment, and can be accomplished with the assistance of facility personnel. While these check-outs are performed, the Contractor shall assist facility personnel in establishing appropriate PID parameters for the installed model configuration.
- The Contractor shall update the existing User's Manual documenting the modified code and its operation.
- The Contractor shall adhere to all applicable LaRC LMS procedures for software configuration management, including LMS-CP-5528 and LMS-CP-5529.

Deliverables and Schedule: Approx. Start Date: January 19, 2007

- LabVIEW VI with phase I modifications. March 15, 2007
- LabVIEW VI with phase II modifications. September 28, 2007
- Updated User's Manual for above LabVIEW VI. R3~~November 30, 2007~~ May 30, 2008
- Documentation required for LMS-CP-5528 and LMS-CP-5529. R3~~December 28, 2007~~ May 30, 2008

Performance Evaluation Criteria: The minimum acceptable level will be the completion of the deliverables. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation.

End R1 block addition

Begin R3 block addition

Subtask 15: Development of Dynamic Loads Measurement Capability:

Michael G. Jones M/S: 463 Phone: 757-864-5272

In support of the Hypersonics Project under the Fundamental Aeronautics Program, the Structural Acoustics Branch is developing capability to measure and analyze the effects of dynamic loads in harsh environments (high temperature, mean flow and dynamic pressure). Support is required in the development and implementation of a test apparatus and associated signal conditioning and data acquisition systems for the evaluation of dynamic loads measurements via high-frequency pressure transducers and/or microphones. Support is also required in the acquisition of dynamic loads data for scramjet tests to be conducted in the NASA LaRC scramjet facilities.

- The Contractor shall provide design and material specifications, assembly and fabrication oversight, and software support for implementation and operation of a test apparatus for evaluation of high-frequency pressure transducer and/or microphone response at elevated temperature.
- The Contractor shall conduct tests (test plan to be supplied by the Government) in this test apparatus to assess the capability of Government-supplied high-frequency pressure transducers and

microphones to measure dynamic loads in harsh environments.
- The Contractor shall provide data acquisition support and instrumentation consultation for scramjet tests to be conducted in NASA LaRC scramjet facilities.

Deliverables and Schedule: Approximate Start Date: June 1, 2008
Completion Date: December 31, 2008
- Design and fabrication of high-temperature test apparatus for evaluation of high-frequency pressure transducers and microphones. June 30, 2008.
- Data report documenting effects of elevated temperature on dynamic response of high-frequency pressure transducers and microphones. July 30, 2008 (contingent on scramjet test schedule).

Performance Evaluation Criteria
Progress toward completion of deliverables will be assessed on a monthly basis. The minimum acceptable level will be completion of deliverables by the required dates. Performance exceeding the acceptable level will be based on:
- Completion of the deliverables at least one month before the required dates.
- Implementation of significant measurement capabilities beyond those included in Government-furnished guidelines.
- Development of software with capabilities significantly exceeding those included in Government-furnished guidelines.

End R3 block addition

Begin R4 block addition

Subtask 16: Hybrid Wing Body Test Project Integration and Management Support

Florence Hutcheson M/S: 463 Phone: 757-864-1054

The purpose of this subtask is to perform project integration and management support for a powered model Hybrid Wing Body (HWB) test currently scheduled for CY 2010 in the 14- by 22-Foot Subsonic Tunnel. The Contractor shall coordinate with all individuals responsible for different aspects of this project to ensure that all elements remain on schedule, and identify any technical, schedule, or other performance concerns to the NASA POC. Specific items to be tracked include, but are not limited to:
- Propane-burning Jet Engine Simulators (JES) for the HWB model
- Fan emulator for the HWB model
- Replacement traversing system for the wind tunnel
- A new ceiling-mounted traversing system for directional array measurements, as well as the array itself
- Replacement acoustic treatment for the tunnel floor
- Facility modifications required to incorporate any of the above

Performance Evaluation Criteria: The minimum acceptable performance of this subtask will be met when the Contractor provides the monthly deliverables by the 5th day of the following month, attends 80% of biweekly project review meetings, and identifies any major technical or schedule risks within two weeks of their occurrence. A higher percentage of meetings attended and identification of risks more rapidly will be used to assess the level of performance exceeding the acceptable level.

Deliverables: Monthly project status reports

Schedule: Start Date: August 1, 2008 Completion Date: December 31, 2009.

*****End R4 block addition*****

Subtask n. Working Environment Safety and Organization

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

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

Schedule: 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:

- On-network DEC ALPHA workstations will be provided. Other special equipment, software, materials, facilities, office space, specialized lab test equipment, and task-specific commercial off the shelf equipment will be provided as required to complete task.
- High level work stations, computers, and accompanying specialized software for processing and analyzing test data, printers, and other peripherals for use during testing and data analysis, and storage media.
- Specialized equipment or products that are required to complete the subtask.
- The Wind Tunnel Data Acquisition system will be used to receive these upgrades. Required hardware, software, shipping costs will be provided by the Govt.
- Measured acoustic signals will be provided to the contractor in the form of data files collected using a multi-channel high speed data acquisition and recording system, either NEFF 495 driven by a DEC Alpha workstation or a PC-base 64-channel high speed DataMax data recorder.
- Subtask 16: a) Test plan. b) Special equipment, software, materials, bulk media, facilities, office space, specialized lab test equipment and commercial off-the-shelf equipment will be provided by NASA as required to complete this subtask.

4. Other Essential Information:

- Complete specifications of the DataMax data recorder are available, as are all specifications for the NEFF 495 data acquisition system.
- Maintain needed certification for operating lasers and other equipment.
- Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the Contractor shall provide documentation, comprised of the

"Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

- Microphone array calibration shall be performed at least at the beginning of the test and calibration files will be stored on the data acquisition computer to permit correction of data to proper sound level units.
- Any data, test procedures, test methods, or inventions generated, produced or implemented by the Contractor shall be the sole property of the Government. However, the Contractor shall be free to publish non-proprietary data in the public domain.
- One 3-day trip to a NASA-sponsored workshop to present data acquired under this task order. The location and date of the workshop is TBD.
- In order to meet some urgent requirements of this task order, the Contractor may have to make various small purchases of materials and equipment such as optical disks, toner cartridges, pressure tubing, and acoustic foam.
- R3>It is anticipated that the Contractor may have to undergo some ad hoc training in software and support tools and to refresh skills, as needed, to support the requirements of this task order.<R3
- Subtask 16: One three-day trip to Boeing Long Beach for test coordination and planning may be required.

5. Security Clearance:

- Security clearances are not required for any of the subtasks herein defined. However, future revisions could require clearances.
- Contractor will be required to sign a nondisclosure statement prohibiting disclosure of Government or private company information to third parties, including other divisions of the Contractor's parent organization.

6. Period of Performance:

Planned start date: January 25, 2007 Completion date: TD1 ~~December 31, 2007~~ R4 ~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Charlotte E. Whitfield
M/S: 461 Phone: 757-864-7152

Other POC (Optional): R3>Michael A. Marcolini
M/S: 461 Phone: 757-864-3629<R3

Subtask POCs (Optional):

Subtask 1.	Thomas F. Brooks	M/S:	461	Phone: 757-864-3634
Subtasks 2-5.	David A. Conner	M/S:	461	Phone: 757-864-5276
Subtasks 6, 7.	TD3>***Florence Hutcheson***	***M/S:***	***463***	***Phone: 757-864-1054***<TD3
Subtasks 8, 9.	R3>William M. Humphreys	M/S:	461	Phone: 757-864-4601<R3
Subtask 10.	Travis L. Turner	M/S:	463	Phone: 757-864-3598
Subtasks 11-13, 15.	Michael G. Jones	M/S:	463	Phone: 757-864-5272
Subtask 14	Mark W. Frye	M/S:	463	Phone: 757-864-4102
R4>***Subtask 16***	***Florence Hutcheson***	***M/S:***	***463***	***Phone: 757-864-1054***<R4

TASK ORDER NUMBER: 028D3-NNL07AM38T Revision: 2 Change: 0 Date: July 9, 2008

Title: **Aircraft Noise Prediction (ANOPP-II) Development, Maintenance, and Support**

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 26RBE)
(Please include reference to SAMS work for transition to TEAMS and possible incumbent staff retention.)
The Aeroacoustics Branch has a continuing responsibility to develop and use computer codes that predict nearfield and farfield noise from all classes of aircraft and their components. The ANOPP code is a repository for noise prediction methods for fixed and rotary wing aircraft. For this contract effort, the ANOPP program as defined in TM-83199 (Parts 1-4) is restricted to conventional take-off and landing (CTOL) aircraft. The current ANOPP Level L03/02/25 will be the baseline prediction system for this effort. This continuation includes the evaluation, verification, validation and documentation of the ANOPP conversion to C++.

The objective of this task is to implement new prediction capabilities for the ANOPP/ANOPP++ prediction system, provide maintenance services for code updates, debugging and corrections, and provide prediction code support to NASA and Government approved ANOPP/ANOPP++ customers. Support will also be provided to research airframe noise, jet noise, and rotorcraft noise.
The government will track progress of the Contractor utilizing monthly technical progress reports, monthly financial reports and comprehensive semi-annual and annual technical oral reviews.

Revision 1 (6/12/07): Extends the period of performance one year to December 31, 2008 in continuation of NASA's support requirements, adds/updates requirements for the new period of performance, and updates the initial task order start date to January 25, 2007 (see R1 below).

Revision 2 (7/9/08): Extends the period of performance one year to December 31, 2009 in continuation of NASA's support requirements, adds/updates requirements for the new period of performance, notes inactive status of Subtask 2.6, and clarifies safety and organization Subtask 2.n (see R2 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 specific support requirements become defined, clarification will be provided to the Contractor. See NOC designated item(s) and description below.

The Contractor shall perform the following subtasks:

2.1 Code Maintenance: (NOC) The Contractor shall maintain a master copy of the ANOPP and ANOPP++ source code on a GFE LINUX computer system. After each new system update generation as required in this subtask (2.1), the Contractor shall deliver an archive copy of the code to the Government. Code changes shall be implemented and tracked using the GFE computer systems detailed in section 3. The Contractor shall maintain a capability to generate executable versions of the code which run on LINUX and PC based computer systems.

The Contractor shall keep an updated executable copy of the code available on the GFE LINUX for Government acquisition and use and shall add each new module, from subtask 2.2 when they are completed. The Contractor shall debug and correct code errors as reported to them by NASA or approved industry customers and shall include a tabulated summary these debugging/correction activities in the archived verification and validation depository as well as the monthly progress reports. If the Contractor determines that a reported error or correction requires a major effort, the Technical Monitor will be contacted for approval before committing resources to implement an update to the code. Under no circumstances shall the Contractor exceed the funding level approved by the Contracting Officer. The Contractor shall distribute updated or corrected copies of the ANOPP and ANOPP++ code to those customers that are approved by the Government. The Contractor will not be held responsible to actively support old ANOPP versions if the versions are more than four levels behind the current update level.

Performance Metrics/Standards:

Meets: The Contractor is expected as a minimum to provide easily readable archived copies of the master codes. The new codes as specified under task 2.2 shall be incorporated into each respective archived copy of the code.

Exceeds: If the code can be easily accessed with only minor problems for execution and the technical documentation is completed for the included codes for each archived code copy, then these criteria will be used accordingly to assess a level of performance exceeding the acceptable level.

Deliverables and schedule:

1. Updated archived ANOPP and ANOPP++ on the DVD and NASA Langley Distributed Mass Storage System monthly.
2. Monthly progress report tabulated summary of debugging/correction activities giving dates reported and corrected/archived and brief descriptor.

2.2 Implementation of Code Updates: The Contractor shall implement into ANOPP/ANOPP++, prediction codes or module updates being developed by the Government or its contractors. This effort shall include the generation of the appropriate technical documentation for the new prediction modules or updates. The Government will make an effort to share with the Contractor beta versions or code components as soon as they become available to the government or are readied by the Government. Following are the known code modules (or updates) currently under development for predicting source noises:

(a) Boeing airframe module (update)
(b) Coaxial jet noise module (update)
(c) Stone jet noise module (update)
(d) INM interface modules (update)

Begin ^{R1} block addition

(e) Heidmann fan module (update and rewrite)
(f) WEF module (update)

End ^{R1} block addition

Begin ^{R2} block addition

(g) Boeing fan module: BFN (update and rewrite)
(h) Self noise module: Brooks method
(i) Multiple Source Noise module (MSN)
(j) Boeing flap noise (Guo method)
(k) NASA flap noise (Brooks method)

*****End R2 block addition*****

Performance Metrics/Standards:

Meets: The Contractor is expected to deliver completed codes (source and executable versions) with documentation concerning input, output and results of execution of each of the codes. The codes shall be demonstrated to reproduce the government furnished results using the data that was used for code development and/or validation.

Exceeds: In addition to the generation of the code module technical documentation, the generation of documentation to introduce persons to the operation of code and other written information or ideas and concepts which result in making the utilization of the code easier or faster executing will all be used to assess a level of performance exceeding the acceptable level.

Deliverables and schedules: ANOPP/ANOPP++ Source module code with documentation as follows:

R1 ANOPP Source modules:	Due date
(a) Boeing airframe module (update)	03/30/07
(b) Coaxial jet noise module (update)	03/30/07
(c) Stone jet noise module (update)	R1 09/30/07
(d) INM interface modules (update)	R1 09/30/07

Begin R1 block addition

ANOPP++ Source modules:	Due date
(a) Boeing airframe module (update and C++ implementation)	06/30/08
(b) Coaxial jet noise module (update and C++ implementation)	05/30/08
(c) Stone jet noise module (update and C++ implementation)	03/30/08
(d) INM interface modules (update and C++ implementation)	01/30/08
(e) Heidmann fan module (update and C++ implementation)	12/31/07
(f) Write external file module (update and C++ implementation)	03/30/08

End R1 block addition

*****Begin R2 block addition*****

ANOPP++ Source modules:	Due date
(a) Boeing airframe module (update and C++ implementation)	09/30/08
(b) Coaxial jet noise module (update and C++ implementation)	12/30/08
(c) Stone jet noise module (update and C++ implementation)	07/30/08
(d) INM interface modules (update and C++ implementation)	09/30/08
(e) Heidmann fan module (update and C++ implementation)	07/31/08
(f) Write external file module (update and C++ implementation)	11/30/08
(g) BFN: Boeing Fan Noise module (update and C++ implementation)	06/30/08
(h) Self Noise module (Brooks method) (update and C++ implementation)	06/30/09
(i) Multiple Source Noise Module (update and C++ implementation)	03/30/09
(j) Flap noise module (Boeing/Guo) (update and C++ implementation)	09/30/09

(k) Flap noise module (Brooks) (update and C++ implementation) 12/31/09
*****End R2 block addition*****

2.3 Government and Customer Software Support:(NOC) The Contractor shall provide NASA and its approved customers support as follows:

a. The Contractor shall use ANOPP/ANOPP++ or other government-furnished codes such as the FAA's Integrated Noise Model, ASACNIM, NoiseMap, or the NASA-LaRC Flight Operations code/programs to generate predicted community noise footprints and certification levels for candidate aircraft scenarios as defined in writing by the Technical Monitor. This shall also include studies to investigate the potential upgrade of ANOPP/ANOPP++ to increase the prediction fidelity for engine attitude effects, lateral attenuation effects and forward flight effects. It is anticipated that no more than six studies or scenarios will be required per year.

b. The Contractor shall use ANOPP/ANOPP++ or other government-furnished codes to determine the component, total engine, total airframe noise, and total aircraft noise for a large twin and regional jet during approach, takeoff and standard flight profiles.

Performance Metrics/Standards:
Computation of narrowband, one-third octave spectra, A-weighted Sound Levels, Sound Exposure Levels (SEL), Day/Night Average Sound Levels (DNL), Noise exposure Forecasts (NEF), Perceived Noise Levels (PNL), Tone Corrected Perceived Noise Levels (PNLT), and Effective Perceived Noise Levels (EPNL) shall be in accordance with the established noise metrics standards (NASA CR 3406) or Federal Air Regulations, Part 36.
Meets: Results of ground level contours or study results for the above metrics is expected within *four weeks* of the written request.
Exceeds: Results of ground level contours or study results for the above metrics provided within *three weeks* of the written request.

Deliverables and schedule: Reports summarizing prediction results for the aircraft studies and scenarios provided within four weeks of the respective requests.

2.4 ANOPP++ System Redesign and Implementation Support: The Contractor shall provide support for a Government contracted effort to redesign and code a new, more efficient, user-friendly version of the ANOPP called ANOPP++. The services provided shall include maintenance, documentation, verification and validation of ANOPP++ to ensure backward compatibility with ANOPP and accuracy of results. While the actual coding and code structural components may change, the functionality and results obtained must be assured to be consistent with the results obtained from the original ANOPP. It will be the responsibility of the Contractor to insure that any new code development is compatible with the current software code control system and system generation procedures.

Performance Metrics/Standards:

Meets: As a minimum the Contractor is expected to provide the Technical Monitor with periodic reports of compatibility between the new and old code results commensurate with the redesign progress.

Exceeds: If the Contractor suggests remedies for and/or sources of problems noted that are on target, then these criteria will be used accordingly to assess a level of performance exceeding the acceptable level.

Deliverables and schedule: The Contractor shall update ANOPP++ to ANOPP-Level 25, provide electronic documentation for ANOPP++, maintain archived versions of all source and documentation within CVS. Monthly progress reports and archived versions and documentation of ANOPP++ system.

2.5 Analysis Methods for PIV: The Contractor shall implement methods specified by NASA to analyze PIV (Particle Image Velocimetry) vector maps of the wake flow field

a. Write analysis codes to determine characteristics of the vortex wake (such as vortex center, vortex core size, vortex strength, and turbulent characteristics) by different methods in either FORTRAN or C to run on a LINUX workstation.

b. Process HART 2 PIV vector maps and QFF grid turbulence PIV vector maps for selected conditions (by NASA) using the analysis codes developed.

Performance Metrics/Standards:
Meets: The Contractor is expected as a minimum to demonstrate the capability to extract vortex properties (core size and strength) from PIV vector maps.
Exceeds: A level of performance exceeding the minimum acceptable performance would be demonstrated by the "user-friendliness" and documentation of codes developed (under this task).

Deliverables and schedule: Database of results and associated documentation including data processing software by R2 ~~06/25/2007~~ ***6/30/2009***.

2.6 Developing and Maintaining EDAS Capabilities: R2 ***(Inactive)*** The Contractor shall continue to populate the EDAS with existing databases such as HART 2 and flight acoustic databases as provided by NASA.

Performance Metrics/Standards:
Meets: The Contractor is expected as a minimum to demonstrate EDAS capabilities to store and archive model and flight data.
Exceeds: A level of performance exceeding the minimum acceptable performance would be demonstrated by the "user-friendliness" and documentation of EDAS.

Deliverables and schedules: Summarize support in monthly progress reports.

2.7 Analysis Codes Development: The Contractor shall develop analysis codes using signal processing methods and theory. These codes will be used to (1) support investigation of the fixed wing and rotorcraft source noise generation from measured data and (2) develop and advance the prediction capabilities for fixed wing and rotorcraft source and system noise. Codes shall be written to run on a UNIX workstation in FORTRAN, C and/or other appropriate languages.

Performance Metrics/Standards:

Meets: The Contractor is expected to deliver completed codes with documentation concerning input, output and results of execution of each of the codes. The codes shall be demonstrated to reproduce results using the data that was used for code development and/or validation.

Exceeds: In addition to the generation of the code module technical documentation, the generation of documentation to introduce persons to the operation of code and other written information or ideas and concepts which result in making the utilization of the code easier or faster executing will all be used to assess a level of performance exceeding the acceptable level.

Deliverables and schedule: All source code with documentation by 12/31/2007.

2.8 Flight Test Data Reduction and Noise Prediction: (NOC) The Contractor shall provide support for the reduction of flight test data for fixed wing and rotorcraft. The Contractor shall provide noise prediction support for noise assessments and the enhancement of noise propagation codes.

Performance Metrics/Standards:

Meets: Computation of source noise hemispheres for each flight condition shall be computed and processed in graphic format. Minimum acceptable percentage of data runs processed in this timeframe is 80 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process.

Exceeds: Greater percentage of processed data runs, as well as additional noise metrics, aircraft state and tracking data made available in this timeframe will be used to assess the level of performance exceeding the acceptable level.

Deliverables and schedules: Source noise hemispheres in electronic and graphical format.

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: 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 Government will furnish one DEC Alpha 3000, three PC's running Windows XP, and one PC running Linux to be used to maintain the master ANOPP/ANOPP++ code copy, for implementation of new prediction code capability, to perform acoustic system studies, and to debug and/or correct code errors.

- The Government will furnish an approved list of ANOPP/ANOPP++ customers. This list will serve as an example of the customer database that is to be maintained by the Contractor and to serve as the basis for determining customer support requirements.

- The Government will furnish on the schedule shown below the databases and/or computer codes along with documentation to provide the basis for the prediction code generation specified in subtask 2:

Source modules/data	Date
(a) Prediction of a 777 and Regional Jet	12/31/07
(b) Prediction and validation/documentation of airframe noise modules	07/31/07
(c) Prediction and validation/documentation of jet noise modules	09/30/07
(d) ANOPP/ANOPP++ INM interface	09/30/07
(e) ANOPP++ system with documentation	10/30/07

4. Other Essential Information:

- To accomplish the implementation of new prediction capabilities for the ANOPP/ANOPP++ systems and to provide maintenance services for code updates, debugging and corrections, the Contractor is required to implement the practices and methodologies consistent with TMX-74029, ANOPP Programmers' Reference Manual for the Executive System and TM-84486, Aircraft Noise Prediction Program User's Manual.

- Under NASA LMS-CP-5528, the ANOPP has been classified as low controlled NASA software. As such the Contractor is expected to implement software development and configuration control procedures consistent with this LMS procedure. Additionally as required by LMS-CP-5528, the Contractor is expected to implement and follow a software configuration management plan according to the requirements specified in LMS-CP-5529.

- The ANOPP/ANOPP++ computer code, its databases and documentation are to be considered as U.S. Government controlled property. The Contractor shall not distribute or disclose any of the material/information/data associated with this code without the expressed written consent of the Government. Additionally, some of the databases, technical information and codes to be worked with may be company proprietary or LERD. It is a requirement of this task that the Contractor abide by any such NASA agreements for the handling of these data bases, technical information, and codes.

- To insure compliance with NPD 2210.1, External Release Of NASA Software, and as the intent of NASA is to share the contents of the ANOPP prediction system with other Government agencies and

U.S Industries, the Contractor shall assign the intellectual property rights to NASA for any codes developed for or prepared for use with the ANOPP/ANOPP++ system.

- Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the Contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

5. Security Clearance: None of the work required is classified

6. Period of Performance:

Planned start date: [R1] January 25, 2007 Completion date: [R1] ~~December 31, 2007~~ [R2] ~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Casey L. Burley
M/S: 461 Phone: 757-864-3659

Other POC (Optional): Michael A. Marcolini
M/S: 461 Phone: 757-864-3629

TASK ORDER NUMBER: 029D3-NNL07AM39T Revision: 4 Change: 0 Date: December 17, 2008
Title: Structural Acoustic Modeling

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 13RBF.)
The purpose of this subtask is to develop validated vibroacoustic finite element [R2]and energy based models of [R2]conventional metallic, stiffened composite and honeycomb core laminated aircraft sidewall structures.

Revision 1 (2/27/07): Adds requirements as new Subtask 2, extends the Task Order period of performance and Subtask 1 schedule six months to December 31, 2007, notes NOC process in Subtask 1, and re-designates safety and organization subtask as "2.n" (see [R1] below).
Revision 2 (11/16/07): Adds requirements as new Subtask 3 with updated purpose and GFI, extends Task Order period of performance 12 months to December 31, 2008, clarifies safety and organization Subtask 2.n and purpose (see [R2] above and below).
Revision 3 (6/4/08): Extends the period of performance 3 months to March 31, 2009 in continuation of NASA's support (see [R3] below, Section 6).
Revision 4 (12/17/08): Extends the overall and Subtask 3 period of performance 9 months to December 31, 2009 in continuation of NASA's support and adds requirements as new Subtask 4 (see [R4] below).
Technical Direction 1 (4/9/09): Notes potential need for equipment calibration, metrology, and/or consultation (see [TD1] below, Section 4).

2. Description of the Work to be Performed: (See LMS-CP-5523, Appendix A)
[R1]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 Subtask 1: [R1](NOC) Refine and Validate High Performance Honeycomb Core Composite Panel Models:
Recessed/patched honeycomb core panels have previously been studied that provide improved transmission loss although often with lower static loads capacity. In this subtask, The Contractor shall model panels that use a variety of recessed/patch configurations to determine if recessed panels can be modeled and built with bending and shear stiffness equivalent to the solid core baseline. The Contractor shall cooperatively develop with NASA panels that maintain bending stiffness (load carrying) while reducing the shear stiffness (radiation efficiency). The Contractor shall compare/validate vibration and acoustic radiation predictions due to point force excitations and reverberant acoustic excitation against NASA provided measured vibration and radiation data. The Contractor shall perform transmission loss predictions when applicable. The Contractor shall provide wave number and loading analysis for all panel configurations.

2.1.1 Milestones (Optional): (N/A)

2.1.2 Deliverables and Schedule (Required):
Informal report documenting the development of the model, the design specification of each panel and the results from the FEM data validating the prediction against NASA supplied test data. [R1]~~June 30, 2007~~ December 31, 2007

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 each panel group as define by NASA. Performance exceeding the acceptable level will be based on accuracy and

efficiency of implementation and range of concepts that have potential for improved structural acoustic performance.

[R1]2.n Subtask 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.

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.

Begin [R1] block addition

2.2 Subtask 2 - (NOC) Acoustic Testing of Prototype Launch Vehicle Subcomponents

POC: Stephen A. Rizzi M/S: 463 Phone: 757-864-3599

The X-37 project has as part of its project plan the development of hot-structure control surfaces. NASA Langley has responsibility for performing spectrum controlled high intensity acoustic tests of the Ruddervator subcomponent. The acoustic tests are to be conducted in the reverberation room of the NASA Langley Structural Acoustic Loads and Transmission (SALT) facility located in Building 1208. The tests are to be performed at room temperature. The structure is to be subjected to a 1/3-octave band acoustic spectrum corresponding to the envelope of the AtlasV and Delta IV launch environments for a specified duration. Acoustic control is to be performed using a 1/3-octave band control system. Data acquisition is to include acoustic data from microphones located in the reverberation room, and accelerometers and strain gages located on the structure being tested. It is anticipated that total duration of each test including set-up time will be 2-3 days with an additional 3-5 days required for data post-processing and informal test report generation. The anticipated date for the C/SiC ruddervator acoustic test is the second part of January. In addition, a controlled high intensity acoustic test shall be performed for a one-foot-square insulation blanket. Execution of this test is tentatively scheduled for late February. The dates are subject to change.

The Contractor shall be responsible for set-up and run of the acoustic control system, set-up and run of the IDEAS or SmartOffice data acquisition system, instrumentation set-up including calibration, data post-processing [to be specified within an electronic Notice of Clarifications (NOC)], and informal and archival test report generation.

2.2.1 Milestones (optional): (N/A)

2.2.2 Deliverables and Schedule: Informal test reports shall be completed within five working days following completion of each test. Draft NASA Contractor Reports (NASA/CR) shall be submitted by the deliverable date for NASA evaluation and publication approval. The test reports shall fully document the tests and include test logs, digital photographs of the test set-ups, data acquisition and signal processing parameters (including instrumentation and calibration), and sample data plots from both control and data acquisition systems. The data post-processing and data format will be specified within a NOC. This subtask shall be completed by May 31, 2007.

2.2.3 Performance Metrics/Standards: The minimum acceptable performance is the successful and timely completion of the requirements above. Performance exceeding the acceptable level shall be based on the accuracy and completeness of the informal and draft formal reports.

End [R1] block addition

Begin [R2] block addition

2.3 Subtask 3 - (NOC) Modeling and Experimental Data Analysis for Rotorcraft Structures

POC: Randolph H. Cabell M/S: 463 Phone: 757-864-5266

The purpose of this subtask is to develop and validate models of the middle and high frequency vibroacoustic behavior of stiffened cylindrical structures and composite panels. This includes the development of energy-based models of the vibroacoustic response of structures that are relevant for rotorcraft interior noise. These models will be validated and compared with NASA-provided experimental measurements. The aluminum testbed cylinder (ATC) will initially be studied. Existing finite element (FE) models of the ATC will be used to develop energy finite element (EFE) and statistical energy analysis (SEA) models of the ATC. Predictions of the vibration response of the ATC sidewall at 1/3-octave band intervals will be compared with NASA-supplied experimentally measured vibration levels. Using lessons learned from the ATC work, EFE and SEA models will be developed of a carbon fiber composite cylinder and its interior, starting from a NASA-supplied finite element (NASTRAN) model. Predicted wall vibration and interior acoustic levels at 1/3 octave bands will be compared with experimentally measured values. Discrepancies between measurements and predictions will be documented

2.3.1 Milestones (optional): (N/A)

2.3.2 Deliverables and Schedule: An informal report documenting model development and updating for the ATC, as well as agreement with measured data. A formal report at the conclusion of the work on the composite cylinder, documenting general modeling suggestions and best practices for obtaining energy models of such structures that produce reasonable agreement with measured data.

2.3.3 Performance Metrics/Standards: The minimum acceptable level will be an informal report delivery upon completion of the ATC, and a formal report at completion of the subtask. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation, and documentation of best practices for obtaining accurate energy models of the studied structures.

End [R2] block addition

Begin [R4] block addition

2.4 Subtask 4 - (NOC) Psychoacoustic Testing to Determine effects of Sonic Booms on People

Planned start date: January 26, 2009 Completion date: December 31, 2009

POC: Alexandra Loubeau M/S: 463 Phone: 757-864-2361

The purpose of this subtask is to design and conduct psychoacoustic experiments to determine effects of sonic booms on people. To this end, Standard Operating Procedures shall be developed for the new indoor sonic boom simulator. One or more tests will be conducted to investigate human response to sonic booms as heard in an indoor environment. Test variables shall include boom amplitude, spectral shape, and presence and type of rattle sounds. Statistical analyses of the data shall include evaluation of a range of acoustical metrics.

2.4.1 Milestones (optional): (N/A)

2.4.2 Deliverables and Schedule: SOP's for the new sonic boom facility. An informal report documenting each experiment, the results and conclusions.

2.4.3 Performance Metrics/Standards: The minimum acceptable level will be the SOP and the delivery of an informal report upon completion of the task. Performance exceeding the acceptable level will be based on accuracy and completeness of the informal report(s).

*****Begin [R4] block addition*****

3. Government Furnished Items: MSC/NASTRAN, MSC/PATRAN, COMET/Acoustics, [R2]EFEA programs and documentation. Computer workstation with a high-resolution display for modeling and code execution. [R4>]***Psychoacoustic test facilities.***[<R4]

4. Other Essential Information:

[TD1>]***Within the experimental and validation aspects of this task order, it is understood that some equipment calibration, metrology, and/or consultation may be required.***[<TD1]

5. Security Clearance:

6. Period of Performance:

Planned start date: January 25, 2007 Completion date: [R1]~~June 30, 2007~~
[R2]~~December 31, 2007~~
[R3]~~December 31, 2008~~
[R4]~~March 31, 2009~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Richard J. Silcox

M/S: 463 Phone: 757-864-3590

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 030D3-NNL07AM40T Revision: 4 Change: 0 Date: June 5, 2008

Title: Technology to Support Scramjet-powered Flowpath Development

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01OCB)

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

Relevant Technical Documents/ Bibliography of Reference Material:
(Note: Contact the NASA LaRC Technical Library for copies of these documents)

Jachimowski, C. J.: An Analysis of Combustion Studies in Shock Expansion and Reflected Shock Tunnels. NASA TP-3224, July 1992.

Jentink, T. N.: An Evaluation of Nozzle Relaminarization Using Low Reynolds Number K-e Turbulence Models. Presented at the 31st Aerospace Sciences Meeting, January 11-14, 1993, Reno, Nevada. AIAA Paper No. 93-0610.

Kamath, P.S. and Mao, M.: Computation of Transverse Injection into a Supersonic Flow with the SHIP3D PNS Code. Presented at the AIAA Fourth International Aerospace Planes Conference, Orlando, Florida, December 1-4, 1992.

Kamath, P. S.; Hawkins, R. W.; and McClinton, C. R.: A Highly Efficient Engineering Tool for Three-Dimensional Scramjet Flowfield and Heat Transfer Computations. Presented at the Computational Fluid Dynamics Symposium on Aeropropulsion, April 24-26, 1990, NASP CP 3078.

Riggins, D. W.; McClinton, C. R.: Analysis of Losses in Supersonic Mixing and Reacting Flows. Presented at the AIAA/SAE/ASME/ASEE 27th Joint Propulsion Conference and Exhibit, June 24-27, 1991, Sacramento, CA. AIAA Paper No. 91-2266.

Srinivasan, S.; Bittner, R.D.; Bobskill, G.J. and McClinton, C.R.: Summary of the Code Validation Effort of GASP for Scramjet Combustor Flow Fields. Presented at the 29th AIAA/SAE/ASME/ASEE Joint Propulsion Conference, June 28-July 1, 1993, Monterey, CA., AIAA Paper No. 93-1973.

Revision 1 (2/28/07): Adds requirements as new subtask 2.3 and re-designates safety and organization subtask as 2.n (see [R1] below).

Revision 2 (5/9/07): Updates the initial task order start date to January 25, 2007, travel requirements to include training, and subtask 2.3 to recognize the uncertainty of predicting the CFD results (see [R2] below).

Revision 3 (9/6/07): Extends the period of performance 12 months to December 31, 2008 in continuation of

NASA's support (see [R1] below, Section 6)
Revision 4 (6/5/08): Adds technical requirements to support Scramjet Test Complex and Eight-Foot High Temperature Tunnel test activities, extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support, and clarifies safety and organization Subtask 2.n (see [R4] below).

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

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

2.1 Design and analysis of Scramjet Powered Flight Vehicles.

A. The Contractor shall support flight activities to include aerodynamic and aero-thermodynamic analysis by conducting Computational Fluid Dynamic (CFD) analysis. This analysis task includes external and internal airframe calculations using appropriate codes and methodologies. Additionally, the Contractor shall support the engine thermal-load analysis, the fuel sequencing analysis, the flight data acquisition and retrieval quick-look analysis, the CFD analyses associated with the HYPULSE test database, and relevant performance and operability design analysis required to aid in the accomplishment of the task including available flight data.

B. The Contractor shall support vehicle developmental efforts. The task includes: providing a test engineer for the mixing and combustion experimental investigations conducted at the LaRC propulsion complex, in conjunction with propulsion system support in the 8-HTT, and associated CFD/experimental coordination activities for vehicle inlet design effort; as well as, staff to accomplish engine-vehicle integration analysis, flowpath and operability assessment analysis, and complete vehicle CFD analysis, APAS configuration assessment, aerothermal configuration analysis, open-cowl and fuel-on delta force analysis, and an assessment of lessons-learned, as well as relevant performance and operability design analysis required to aid in the accomplishment the task. The task also includes providing aerodynamic, propulsion, CFD, and thermal analysis for scramjet flight experiment(s) and related tests.

C. The Contractor shall provide technical personnel, with expertise in pulsed-facility research, to address the feasibility of potential upgrade(s) to the NASA-HyPULSE facility, via the incorporation/modification of existing NASA-owned, large-scale, pulsed-facility hardware. The Contractor shall interface with other NASA contractors, addressing similar technical efforts, to aide in the accomplishment of this task. The Contractor shall report the technical work performed using monthly technical progress reports.

D. The Contractor shall perform Computational Fluid Dynamic evaluations of CEV ground-experimentally derived data sets, and flight-type environments. This work is highly synergistic with the existing hypersonic aerodynamics, has been performed for airbreathing configurations of interest and also allows for verification of computational algorithms and techniques required for airbreathing propulsion systems.

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

E. The Contractor shall support test activities in the NASA LaRC Scramjet Test Complex and Eight-Foot High Temperature Tunnel. The task includes: providing Programmable Logic Control and Process Control software design, implementation and checkout, selection of control hardware compatible with existing control systems to ensure the proper interface, integration and functionality, design and conduct of integrated system functional tests to ensure proper operation prior to commissioning, and trouble shooting of hardware and software problems on existing control systems.

F. The Contractor shall perform Computational Fluid Dynamic analysis in support of aerothermodynamic tests performed in the Langley Eight -Foot High Temperature Tunnel.

****End R4 block addition*****

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

a. The flight, developmental, and CEV activity aerodynamic results shall be presented in the form of integrated force and moment data, component loads, and pressure and thermal loads. All significant subtasks shall be documented employing standard NASA reporting mechanisms. Note that informal status reports shall be submitted on a case-by-case basis to supplement the monthly progress reports (as coordinated with TM). Due date: 30 working days after technical subtask completion
b. The Contractor shall document all significant findings and results of upgrade feasibility employing a standard NASA reporting mechanism. Due date: 30 working days after technical subtask completion

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

MEETS:
- Meet schedule and cost.
- Comparisons with experimental data to validate solutions (if available).
- Results documented in Contractor Report and/or meeting papers.

EXCEEDS MINIMUM REQUIREMENTS:
- Perform effort such that a reduction of schedule and cost is achieved.
- Solutions/analysis consistent with standard NASA/Industry procedures and calibration/validation procedures
- Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

2.2 SRGULL Propulsion Design Code Update, Documentation and Distribution.

A. The Contractor shall continue to upgrade the code to efficiently converge the isolator reattachment

model, in the flight Mach 3-7 speed range, utilizing the X-43A/B/C configurations.
B. The Contractor shall review, update and distribute SRGULL code and documentation (consistent with user requirements).
C. The Contractor shall validate the code with existing engine data (as it is made available via the on going NASA hypersonic programs). This validation shall include both dual-mode scramjet and RBCC (Rocket Based Combined Cycle) data (both with hydrogen and hydrocarbon fuels). This data is projected to be primarily X43-C data coupled with well-documented previous NASA hypersonic engine tests.
D. The Contractor shall support external LaRC users as coordinated with LaRC TM.
C. The Contractor shall apply SRGULL to generate propulsion datasets/databases for NASA Next Generation Launch Technology program and other historical datasets, and initiate the implementation, and application, of finite-rate kinetics analysis methods (for hydrogen and hydrocarbon fuels) within the SRGULL code in the coordination with the LaRC TM).

2.2.1 Milestones (Optional):

2.2.2 Deliverables and Schedule (Required):

a. Continue enhanced documentation for Mach 3-7 isolator model, and associated SRGULL code modifications. Due date: 30 working days after technical subtask completion
b. Document application of SRGULL to the X-43/A/B/C database. Due date: 30 working days after technical subtask completion
c. Documentation of significant technical findings. Due date: 30 working days after technical subtask completion
d. Documentation of significant technical findings. Due date: 30 working days after technical subtask completion
e. Documentation of technical results. Due date: 30 working days after technical subtask completion

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

MEETS:
- Meet schedule and cost.
- Solutions/analysis consistent with standard NAO-CSO/CFD procedures and calibration/validation procedures.
- Results documented in Contractor Report and/or meeting papers.

EXCEEDS MINIMUM REQUIREMENTS
- Perform effort such that a reduction of schedule and cost is achieved.
- Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

Begin [R1] block addition

2.3 CFD Database Development.

POC: Mary Beth Wusk M/S: 255A PHONE: 757-864-3830

A. The Contractor shall complete [R2]CFD runs specified by the NASA Mission Integration Manager, and additional runs as necessary to verify data linearity (or document non-linearity) and [R2]accuracy.

[R2]~~B. The Contractor shall analyze solution flow fields to identify origins of unusual phenomena observed in the force and moment data (e.g. tip vortices, separation)~~
C. The Contractor shall evaluate adequacy of gridding, turbulence model, and other inputs in producing accurate force and moment data.
D. The Contractor shall maintain pedigree/traceability of solutions to grids, flow conditions, and other inputs used.
E. The Contractor shall complete CFD solutions at wind tunnel conditions [R2] ~~to evaluate code capability and accuracy~~.
[R2]~~F. The Contractor shall utilize solutions at wind tunnel and flight conditions to generate ground-to-flight scaling.~~
G. The Contractor shall perform grid refinement study to insure that results obtained are grid converged.
H. The Contractor shall verify that all solutions meet established convergence criteria to insure that all solutions are iteratively converged.
[R2]~~I. The Contractor shall support code-to-code comparisons of results.~~

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

a. Support open communication with the team via telecons and informal meetings. *Ongoing*
b. Support documentation of database resulting from the NASA defined CFD runs via formal report. ~~The following schedule provides target dates for the deliveries but may be updated by the HSA Mission Integration Manager.~~

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

MEETS:

- Meet schedule and cost.

Results documented in test reports as listed above.

EXCEEDS:

- Perform effort such that a reduction of schedule and cost is achieved.
- Results archived in the mission's configuration management system and ready for release to the Tiger Team and subsequently ATK (Div of GASL, subject to NASA release procedures).

End [R1] 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 [R4]***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 Specialized Computer Resources:

- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing Facility.
- Access to a secure Cray J90 (8 CPU'S, 4-GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks
- BEOWULF Cluster

3.2 Available Specialized Software:

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

3.3 Special items:

- Safes for storage of classified material
- Private/secure office for task leader

4. Other Essential Information:

4.1 Estimated Travel requirements:

Performance of these tasks may require travel to: Marshall Space Flight Center, Norfolk Va., Kennedy Space Center, Dryden Flight Research Center, Edwards, CA; Glenn Research Center, Cleveland, OH; GASL (Allied Aerospace Inc.), Ronkonkoma, NY; Boeing North American, Seal Beach and Canoga park, CA; Microcraft, Tullahoma, TN and Ontario, CA; Pratt & Whitney, West Palm Beach, FL; Aerojet, Sacramento, CA; and participation in JANNAF Propulsion meetings, and appropriate international forums.

Dissemination of information (subject to the NASA-LaRC release authorization procedures) at foreign conferences is an anticipated requirement. [R2]Some training travel may be necessary.

5. Security Clearance:

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

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

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

6. Period of Performance:

Planned start date: [R2]January 25, 2007 Completion date: [R3]~~December 31, 2007~~

[R4]~~December 31, 2008~~

December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Dr. Aaron Auslender
M/S: 168 Phone: 757-864-6545

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1
TASK ORDER NUMBER: 031D3-NNL07AM41T Revision: 2 Change: 0 Date: August 5, 2008	
Title: **Design and Development of Test Hardware for Deployable Structures**	

1. Purpose, Objective, or Background (Optional) (Extension and modification of SAMS Task Order 03RFF)

Provide Engineering design and development of test hardware in support of Langley's deployable structures program. The task is being extended to cover additional work under the ISAT program, and modified to include work under the Exploration Inflatable structures task in the Structures and Mechanisms program. The task is currently funded under the DARPA reimbursable program for Innovative Space-based-radar Antenna Technology (ISAT) and additional funding will be provided under the Exploration program. The specific objective of the work to be performed under the present task is to design fixtures and instrument-mounting hardware to be used in axial compression and tension, bending, and vibration tests of thin-walled, inflatable columns and trusses, and support the test activities. The task is modified to include mechanically deployed antenna structures and inflatable habitat-type component structures.

Revision 1 (8/23/07): Extends the period of performance 12 months to September 30, 2008 in continuation of NASA's support and updates the schedule and anticipated travel accordingly, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007 (see [R1] below).
Technical Direction 1 (03/20/08): clarifies safety and organization Subtask 2.n and potential materials purchases in Section 4 (see [TD1] below).

Revision 2 (8/5/08): Extends the period of performance 11 months to August 31, 2009 in continuation of NASA's support, updates the schedule, and adds requirements to support creep tests of inflatable habitat material (see [R2] 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 hardware requirement becomes defined, the Technical Monitor will provide clarification to the Contractor. See NOC designated item(s) and description below.

2.1 (NOC) Development, Fab Coordination, Test Integration and Support:

The Contractor shall develop designs for, and coordinate fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, bending, and vibration tests of thin-walled inflatable truss components and mechanically deployed truss components.

The Contractor shall develop designs for, and coordinate fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, and combined load tests of inflatable structure sub-components for habitats

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

Begin [R2] block addition

The Contractor shall aid in creep tests for inflatable structure materials. This support shall include:

a. Monitoring the test set up and execution.
b. Providing support for set-up and execution.

c. Acquiring, manipulating, and reducing the data according to NASA provided specifications for test results. Period of performance shall be from Aug 15, 2008 – March 31, 2009.

The Contractor shall provide support for design and oversight of fabrication of end section hardware for an expandable habitat structure. Support shall include support of assembly of hardware into the final test component and operation checkout of inflation deployment. Period of performance shall be from Sept 1, 2008- Aug. 31, 2009.

*****End R2 block addition*****

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

The estimated schedule for all deliverables is dependent on receipt of Government-furnished items such as specimens for testing which are purchased or delivered from other contracts. The estimated completion date for all deliverables is R2***Aug. 31, 2009***. Monthly Status Reports of work accomplished are due by the 15th of the following month.

Deliverables shall include:

- Design drawings of test fixtures
- Integration of specimens into test fixtures R2***and test beds***.
- Set-up of test equipment for test programs
- Data from test runs/ excell format

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

- The hardware shall accommodate inflatable structural specimens ranging in length from 3' to 50'.
- Integration of test specimens into test fixtures for at least 30 specimens and support, at a minimum, compression and tension tests for the 30 specimens.
- For temperature constrained tests the temperatures shall be controlled within the specified tolerance (± 5°C)
- R2>***Integration of hardware components into inflatable testbed with dimensions up to 3.5 m in dia. and 6.5 m in length.***<R2

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 TD1support 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.

TASK ORDER NUMBER: 031D3-NNL07AM41T Revision: 2 Change: 0 Date: August 5, 2008

Title: **Design and Development of Test Hardware for Deployable Structures**

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:

One to two trips to Fredrica, Delaware [R1]per year. Each trip is a two day to confer with the manufactures of the inflatable columns.

[TD1>]In the absence of GFI, Section 3 above, it is understood that small ad hoc materials purchases may be necessary to accomplish the requirements stated above in Section 2 and subsequently clarified by NOC. The Contractor shall decide whether to report these items as "direct" or "indirect". Direct items shall be coordinated with the Technical Monitor in advance.[<TD1]

5. Security Clearance:

None

6. Period of Performance:

Planned start date: [R1]Jan.25, 2007 Completion date: [R1]~~Sept. 30, 2007~~

[R2]~~Sept. 30, 2008~~

Aug. 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Judith Watson

M/S: 432 Phone: 757-864-3116

Other POC (Optional):

M/S: 190 Phone:

TASK ORDER NUMBER: 032D3-NNL07AM42T Revision: 2 Change: 0 Date: September 11, 2008

Title: Hypersonic Airbreathing Propulsion

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 33RBI)
The Hypersonic Airbreathing Propulsion Branch (HAPB) of the Research and Technology Directorate (RTD) at NASA Langley Research Center performs research on the design, testing, and engineering data analysis of airbreathing engine flow paths for propulsion of hypersonic cruise and trans-atmospheric vehicles. These propulsion systems are intended to operate in the supersonic/hypersonic flight regime with combustor flows transitioning from subsonic to supersonic; hence, they are referred to as dual-mode scramjets. Critically important elements of this research include the testing of scramjet engine configurations and components in HAPB scramjet test facilities, the collection of appropriate data, and the evaluation of scramjet performance through engineering and computational analysis of the data. In addition, the development of appropriate methods and processes to understand and interpret the experimental test data, to predict the ramjet/scramjet performance, and to extrapolate experimental data to flight performance is an important requirement.

The objectives of this Task are:

(1) The analysis and interpretation of HAPB experimental scramjet data to obtain performance assessments of various engine flow path configurations.

(2) The operation of HAPB fundamental studies laboratories, inclusive of diaphragm-rupture-dynamics studies and the operation of the Mach-4 Blow Down Facility (M4BDF), inclusive of model installation support

(3) The assessment and improvement of scramjet inlet, combustor, and nozzle concepts through experimental testing and computational fluid dynamics analysis

(4) The enhancements of the multi-block algorithm of the VULCAN CFD code to reduce the time required to perform an analysis of a scramjet combustor, and further modifications to improve the robustness and accuracy of the VULCAN patch-coefficient generation code

The successful performance of this task requires knowledge and experience in a variety of disciplines, including supersonic fluid dynamics, thermodynamics and combustion chemistry of gases, experimental techniques and scramjet test facility operation, computational fluid dynamic codes and their implementation on computer systems, and technical and mechanical operation of experimental apparatus in fundamental studies laboratories.

The metrics for each sub-task describe the minimal acceptable performance. Actions by the Contractor to exceed minimal performance are identified in the sub-Task descriptions.

Revision 1 (9/27/07): Extends the period of performance 12 months in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n with clarified requirements (see [R1] below).

Revision 2 (9/11/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R2] 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 Operation of Fundamental Studies Laboratories: The Contractor shall provide the technical services and operational support for the operation of and data collection in the HAPB fundamental studies laboratories: the Basic Combustion Laboratory, the Nonintrusive Diagnostics Laboratory, the Propulsion Instrumentation Shock Tube Laboratory (PISTL), and the Mach-4 Blow Down Facility (M4BDF) in Building 1221C. The expected outcome of this Task is the orderly and safe operation of the apparatus to meet the research needs of basic combustion, measurement, and pulse facility studies in HAPB. It is anticipated that these facilities will be available for operation/testing throughout the entire period of performance. In the case of any schedule conflicts, priority will be determined by the Technical Monitor.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

(1) Configure and modify existing data acquisition systems to support laser-based diagnostic development and testing in all laboratories. (ongoing)
(2) The fabrication or modification of small mechanical, electrical, or electronic components for use in all laboratories. (ongoing)
(3) Assembly, modification, and operation of gaseous flow apparatus for the Basic Combustion and Nonintrusive Diagnostics Laboratories, the operation of the M4BDF, and for the operation the PISTL facility, inclusive of conducting diaphragm-rupture-dynamics experiments (utilizing PISTL) (ongoing)

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

MEETS:

(1) Operation of the laboratories and fluid systems in a safe and efficient manner in compliance with NASA Safety Regulations, and LAPG 1740.7 (Process Systems Certification Program).
(2) Timely and efficient operation of the various laboratories to meet test schedules.

EXCEEDS MINIMUM REQUIREMENTS:

Suggestions for operation and procedure that significantly improve safety, efficiency, timeliness, and LAPG compliance.

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:

The Government shall make available to the Contractor the following equipment and items:

1. Data acquired in scramjet engine and component tests and the operating conditions of NASA facilities.
2. Access to the HAPB fundamental studies laboratories and the M4BDTF in Bldg. 1221C and to the scramjet test facilities in Bldg. 1221D, Bldg. 1247B, and Bldg. 1265.
3. Access to specialized NASA and LaRC computer systems, including the HAPB distributed UNIX network (hyp00, hyp01), LaRC SNS system (Sabre, Borg, etc.), the NAS system at Ames RC (vonNeuman) and the NASA ACSF system at Ames RC (Eagle), secure computing environments at LaRC (Thunderbolt) and in HAPB (Secure1), and access to the VULCAN computer code and associated software elements.
4. Design details and the propulsive flow path lines of the NASA Hyper-X and ARTT configurations as needed.
5. Access to NASA pulse facilities and operational attributes.

4. Other Essential Information:

5. Security Clearance:

Certain work done under this Task Order will expose the Contractor to classified or sensitive material. Contractors working classified projects shall be U. S. citizens and possess a security clearance level to SECRET, and Contractors working ITAR projects shall be U.S. citizens.

6. Period of Performance:

Planned start date: [R1]January 25, 2007

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

7. NASA Task Management:

Technical Monitor (Required): Aaron H. Auslender

M/S: 168 Phone: 757-864-6545

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 033D3-NNL07AM43T Revision: 2 Change: 0 Date: August 14, 2008
Title: Simulate Closed-Loop Operation of Flight Control System Hardware

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 22RDG)
Research conducted under the Vehicle Systems Program and the Aviation Safety and Security Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. This research will lead directly to the validation of developed advanced technologies under adverse conditions, to processes for compliance demonstrations of complex integrated critical systems; to certification requirements for operation in electromagnetic environments (EME) such as lightning and High Intensity Radiated Fields; to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions. This task provides engineering support in the above research and program areas.
Revision 1 (11/5/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, re-designates safety and organization subtask as 2.n with clarified requirements, and documents the June '07 TM change (see [R1] below).
Revision 2 (8/14/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R2] 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.

2.1 Closed-Loop 737 Simulation: The Contractor shall modify, update, and maintain hardware and software required for closed-loop simulation between (i) the Honeywell Quad-Redundant Computer (QRC), (ii) the Honeywell Recoverable Computer System (RCS), (iii) other selected hardware systems and the B737 aircraft, engine, sensor, actuator, and atmosphere models using analog and discrete interface signals, the appropriate data bus, and/or the 429 data bus.

a. The Contractor shall verify all simulation software for accuracy and fidelity after modifications are made.
b. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.1.1 Deliverables and Schedule (Required): Modified, updated, and maintained software required for closed-loop simulation between the Honeywell Hardware and the B737 aircraft, engine, sensor, actuator, and atmosphere models using analog and discrete interface signals as well as digital data bus. *Ongoing.*

2.1.1 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) All sensor inputs and control command outputs shall be within 10% of the corresponding values generated by Simulink simulation code of the B737 aircraft.

Exceeds: All sensor inputs and control command outputs shall be within 5% of the corresponding values generated by Simulink simulation code of the B737 aircraft.

2.2 Real-Time Experimental Data Display: The Contractor shall modify, update, and maintain hardware and software required for the real-time display of data collected from closed-loop experiments.

a. The Contractor shall verify all data display software for accuracy and fidelity after modifications are made.
b. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.2.1 Deliverables and Schedule (Required): Modified, updated, and maintained software required for the display of data collected from closed-loop experiments. *Ongoing*

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

Meets: (Satisfactory Effort) Aircraft pitch, roll, yaw, throttle command, and lateral and longitudinal displacement from the glideslope shall be displayed in real-time as plots with a delay time not greater than 500 ms of data capture.

Exceeds: Aircraft pitch, roll, yaw, throttle command, and lateral and longitudinal displacement from the glideslope shall be displayed as a real-time 4-D animation with a delay time less than 500 ms of data capture.

2.3 Closed-Loop 757 Simulation: The Contractor shall develop and install software required for closed-loop simulation between (i) the Honeywell Quad-Redundant Computer (QRC), (ii) the Honeywell Recoverable Computer System (RCS), (iii) and/or the Honeywell Distributed Flight Control System and the B757 aircraft (and/or other aircraft), engine, sensor, actuator, and atmosphere models.

a. The Contractor shall verify all simulation software for accuracy and fidelity after installation is completed.
b. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.3.1 Deliverables and Schedule (Required): Software required for closed-loop simulation between one of the Honeywell Computers and the B757 aircraft (and/or other aircraft), engine, sensor, actuator, and atmosphere models. *Ongoing*

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

Meets: (Satisfactory Effort) All sensor inputs and control command outputs shall be within 10% of the corresponding values generated by Simulink simulation code.

Exceeds: All sensor inputs and control command outputs shall be within 5% of the corresponding values generated by Simulink simulation code.

2.4 (NOC) Systems and Airframe Failure Emulation Testing and Integration Laboratory: The Contractor shall provide software support to the development of the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory and its links to other LaRC Laboratories. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Engineer.

2.4.1 Deliverables and Schedule (Required): Software to link operations of the SAFETI Lab and other LaRC Labs. *Ongoing*

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

Meets: (Satisfactory Effort) Delivery of software within 60 days of the NOC.

Exceeds: Delivery of software with documentation within 60 days of the NOC.

2.5 (NOC) Documentation and Tutorial Information: The Contractor shall provide documentation and tutorial information on all closed-loop simulation hardware/software configurations and data collection protocol.

2.5.1 Deliverables and Schedule (Required):

(i) Written document with diagrams of hardware/software configuration, voting schemes, interface requirements, and data collection protocol. *Ongoing*

(ii) Oral tutorial with hand-outs. *Ongoing*

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

Meets: (Satisfactory Effort) Delivery documents/tutorials as agreed in NOC.

Exceeds: Timely delivery with suggestions or solutions for system improvement.

2.6 (NOC) Hardware-in-the-loop Experiments: The Contractor shall support hardware-in-the-loop experiments in the SAFETI Lab and in other laboratories. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.6.1 Deliverables and Schedule (Required): Data acquisition software and experimental test data. *Ongoing*

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

Meets: (Satisfactory Effort) All simulation and data acquisition software shall be completed and verified for accuracy and fidelity prior to each experiment. All nominal data variables shall be within 10% of the corresponding baseline values.

Exceeds: All simulation and data acquisition software shall be completed and verified for accuracy and fidelity, and presented to the Lead Test Engineer for review prior to each experiment. All sensor inputs and control command outputs shall be within 5% of the corresponding baseline values.

2.7 (NOC) Bulk Cable Injection Experiments: The Contractor shall write controlling software for instrumentation and support bulk cable injection experiments in the SAFETI Laboratory. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.7.1 Deliverables and Schedule (Required): Experiment control software, data acquisition software, and experimental test data. *Ongoing*

2.7.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) All experiment control and data acquisition software shall be completed and verified for accuracy and fidelity prior to each experiment. All nominal data variables shall be within 10% of the corresponding baseline values.
Exceeds: All experiment control and data acquisition software shall be completed and verified for accuracy and fidelity, and presented to the Lead Test Engineer for review prior to each experiment. All sensor inputs and control command outputs shall be within 5% of the corresponding baseline values.

[R1]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:

Computer equipment, hardware, software, and equipment associated with the Closed-Loop Systems Laboratory and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work shall be performed in NASA Langley Building 1220 on a non-interference basis.

4. Other Essential Information:

Manuals, schematics, technical reports, and papers will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.

5. Security Clearance:

Security clearance is not required.

6. Period of Performance:

Planned start date: January 25, 2007 Completion date: [R1]~~December 31, 2007~~ [R2]~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): [R1]Kenneth W. Eure
M/S: 130 Phone: 757-864-5990

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

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 034D3-NNL07AM44T Revision: 2 Change: 0 Date: September 23, 2008

Title: Emulate Effects of Controller Malfunctions on Aircraft

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 23RDG)
Research conducted under the Vehicle Systems Program base research program and the Aviation Safety and Security Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. This research will lead directly to the validation of developed advanced technologies under adverse conditions, and to processes for compliance demonstrations of complex integrated critical systems to certification requirements for operation in electromagnetic environments (EME), such as lightning and High Intensity Radiated Fields, to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions.

Revision 1 (7/23/07): Re-designates safety and organization subtask as 2.n, updates the initial task order start date to January 25, 2007, consolidates technical task descriptions and requirements as Subtasks 2.1 through 2.7, extends the period of performance 12 months to December 31, 2008, and documents the technical monitor change with an added POC. (see [R1] below).
Technical Direction 1 (9/21/07): clarifies safety and organization Subtask 2.n and corrects the typo in the completion date (see [TD1] below).
Revision 2 (9/23/08): 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)
Contract paragraph H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs) may apply to this task order.

Begin [R1] block consolidation
2.1 Nonlinear B-737/757 Simulation Support: The Contractor shall support the development and maintenance of a nonlinear B737 and/or B757 simulation(s) in Simulink consisting of individual blocks for the B737/757 aircraft, control laws, engine, sensors, actuators, and atmosphere models. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Project Engineer.

2.1.1 Deliverables and Schedule (Required): Simulink Nonlinear B737 and/or B757 simulation(s). *Ongoing.*

2.1.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) Simulation developed, tested, and debugged with all sensor and command values within 10% of the corresponding values generated by the baseline simulation code of the B737 and/or B757 Simulation(s).
Exceeds: Simulation developed, tested, debugged, and documented with all sensor and command values within 5% of the corresponding values generated by the baseline simulation code of the B737

and/or B757 Simulation(s).

2.2 SAFETI Lab Aircraft Simulations: The Contractor shall support the integration and maintenance of aircraft simulations in the SAFETI Lab consisting of the aircraft dynamics models, equations of motion, control laws, engine, sensors, actuators, and atmosphere models. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Project Engineer.

2.2.1 Deliverables and Schedule (Required): Aircraft simulations implemented in the SAFETI Lab. *Ongoing.*

2.2.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) Simulation developed, tested, and debugged with all sensor and command values within 10% of the corresponding values generated by the baseline simulation code.
Exceeds: Simulation developed, tested, debugged, and documented with all sensor and command values within 5% of the corresponding values generated by the baseline simulation code.

2.3 SAFETI Lab Software Development: The Contractor shall provide software support to the SAFETI Laboratory. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Engineer.

2.3.1 Deliverables and Schedule (Required): Software for use in the SAFETI Lab. *Ongoing.*

2.3.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) Software developed, tested, and debugged.
Exceeds: Software and documentation developed, tested, and debugged.

2.4 Simulation Software Documentation for Research Experiments and Tutorial Information: The Contractor shall modify and maintain aircraft simulation software and documentation in support of research experiments, and provide documentation and tutorial information on Simulink aircraft simulations. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Engineer.

2.4.1. Deliverables and Schedule (Required):

(i) Written document with Simulink diagrams. *Ongoing.*
(ii) Oral tutorial with hand-outs. *Ongoing*
(iii) Software modifications and documentation in support of research experiments.

Ongoing.

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

Meets: (Satisfactory Effort) Software developed, tested, and debugged; including delivery of documents/tutorials in 180 days.

Exceeds: Software and documentation developed, tested, and debugged; including delivery of documents/tutorials in less than 180 days.

2.5 Airborne Subscale Transport Aircraft Research (AirSTAR) Ground Facilities Software: The Contractor shall develop, modify, and maintain software for the Airborne Subscale Transport Aircraft Research (AirSTAR) Ground Facilities in support of research experiments. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Engineer.

2.5.1 Deliverables and Schedule (Required): Software and documentation for the AirSTAR Ground Facilities. *Ongoing.*

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

Meets: (Satisfactory Effort) Software developed, tested, and debugged.

Exceeds: Software and documentation developed, tested, and debugged.

2.6 Development, Modification, and Maintenance of Visualization Software for the Generic Transport Model (GTM) Simulation The Contractor shall develop, modify, and maintain plug-in software for visualizing the GTM vehicle and terrain in support of the GTM simulation. Coordination with the GTM simulation developers will be performed, as needed. All software will be developed, controlled and documented in accordance with the Langley Management System for the level defined by the Lead Engineer. Configuration management will be provided for the developed software.

2.6.1. Assumptions:

(i) Matlab, Simulink, AVDS, and a PC with word processing software will be needed.

(ii) The Project Engineer and other knowledgeable technical staff will be available to answer necessary technical details.

2.6.2. Deliverables and Schedule (Required): Software and documentation for the visualization software plug-in for the GTM simulation. *Ongoing.*

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

Meets: (Satisfactory Effort) Assigned software developed, tested, and debugged by 9/30/07.

Exceeds: Assigned software developed, tested, debugged, and documentation completed by 9/30/07.

2.7 Aircraft Control System Models Code Generation and Experiments: The Contractor shall support hardware-in-the-loop experiments, and update and maintain the capability to use Matlab Real-Time Workshop to develop C code from Simulink simulations, and modify generated code for real-time application in the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory. Work may require scripting development and maintenance to support experiment requirements and data verification and preparation for delivery with software analysis to clarify experimental results. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Lead Engineer

a. The Contractor shall verify the accuracy and fidelity of the C code developed.
b. The Contractor shall develop, control, and document all software in accordance with the Langley Management System for the level defined by the Project Engineer.

2.7.1. Deliverables and Schedule (Required):

(i) Data acquisition software and experimental test data. *Ongoing*.
(ii) Real-Time Workshop C Code of Simulink simulations with modifications required for real-time operation in the SAFETI Laboratory. *Ongoing*

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

Meets: (Satisfactory Effort) Software developed, tested, and debugged in 60 days. All parameter values generated by the C code shall be within 10% of the corresponding values generated by the Simulink simulation. All simulation and data acquisition software shall be completed and verified for accuracy and fidelity prior to each experiment. All nominal data variables shall be within 10% of the corresponding baseline values.

Exceeds: Assigned software developed, tested, and debugged in less than 60 days. All parameter values generated by the C code shall be within 5% of the corresponding values generated by the Simulink simulation. All simulation and data acquisition software shall be completed and verified for accuracy and fidelity, and presented to the Lead Test Engineer for review prior to each experiment. All sensor inputs and control command outputs shall be within 5% of the corresponding baseline values.

End [R1] block consolidation

2.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: Computer equipment, hardware, software, and equipment associated with the SAFETI Laboratory and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work is to be performed in NASA Langley Building 1220 on a non-interference basis.

4. Other Essential Information: Manuals, schematics, technical reports, and papers will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.

5. Security Clearance: Security clearance is not required.

6. Period of Performance:

Planned start date: R1 January 25, 2007 Completion date: R1 ~~December 31, 2007~~
R2 ~~TD1~~ ~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): R1 **Roger M. Bailey**
M/S: 130 Phone: 757-864-2007
Other POC (Optional): R1 **Eric Cooper**
M/S:130 Phone: 757-864-6674

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 1

TASK ORDER NUMBER: 035D3-NNL07AM45T Revision: 1 Change: 0 Date: November 15, 2007
Title: Structural Dynamics Analysis & Testing

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 07RCG)
The Structural Dynamics Branch (SDB) conducts research and technology development to quantify and control impact dynamics, ground operations, and structural dynamics of aerospace systems. SDB: confirms validity of approaches by conducting tests on full-scale structures, structural elements and scaled structural models; conducts research to advance the technology for improving the safety and handling performance of aircraft during all-weather ground operations, including takeoff, landing impact, and ground handling phenomena; develops fundamental understanding of crash behavior and crash-mitigating design; develops and validates predictive tools for crash dynamics; conceives and confirms new dynamic test techniques; operates the Structural Dynamics Research Facility, the Impact Dynamics Research Facility (IDRF), and the Aircraft Landing Dynamics Facility. In particular, the IDRF is used to conduct dynamic testing of full-scale aircraft and space structures. IDRF studies the response of the aircraft/space structures under crash loads so that better energy absorbing systems and better energy management systems can be incorporated into future structures. The IDRF uses Finite Element Modeling (FEM) and sub-scale and sub-component testing to support the design efforts. Programs that the IDRF support are The Aviation Safety Program (AvSP) and Mars Exploration Rover (MER).. The Contractor will be required to develop FEM and perform analyses to support crashworthiness tests and/or analytical studies for structures such as the Fokker 28 aircraft or other AvSP specific projects.

Revision 1 (11/15/07): Extends the period of performance 4 months to April 30, 2008 in continuation of NASA's support at lower than initially anticipated activity, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n with clarified requirements (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. See NOC designated item(s) and description below.

2.1 Analysis of Space Shuttle Wing Leading Edge Impact Scenarios: The CAIB ruled that foam debris from the external tank impacting the Reinforced Carbon-Carbon (RCC) wing leading edge caused the Columbia disaster. One of the major space shuttle return-to-flight (RTF) activities is to determine the damage threshold to the wing leading edge RCC panels. The RCC material is a complex layered composite material and fails similarly to Ceramic Composite Materials. The impact velocities of the debris range from 700 ft/s to over 1000 ft/s. The teams working impact scenarios are located at LaRC, GRC, and at Boeing. This work is sponsored by NASA JSC and is highly schedule driven.

A. The Contractor shall create, run, analyze, post-process and validate multiple LS-Dyna dynamic finite element models to predict the threshold of impact damage to the Shuttle wing leading-edge from various debris including foam, ice, gap filler material, and ablator material. Models may require updating or refinement such as re-meshing using MSC-PATRAN with the LS-DYNA preference. Models/model files may also be required to be compatible with other codes (e. g., ABAQUS, NASTRAN). Most post-processing shall be done with LS-POST/LS-PREPOST. Use of EnSight to make enhanced animations may be needed for some cases.

B. The Contractor shall validate the models for different debris material, material geometries, impact velocities, impact trajectories, locations on the RCC panels, and for a number of different RCC panels. In addition, subcomponent models shall be created to compare with impact test data of RCC panels, test coupons, etc.

C. The Contractor shall coordinate with test engineers and use test data from impacts onto foam and onto RCC to determine and/or modify the inputs for material models in LS-DYNA. Models include complex failure mechanisms and strain-rate effects.

D. The Contractor shall create models using the MSC-PATRAN 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 need to be run to apply flight loads before impact (pre-stressing).

E. The Contractor shall investigate boundary conditions for flat plate RCC panels including modeling of rod supports.

F. The Contractor shall complete the SwRI Panel 8 LS-DYNA model.

G. The Contractor shall model using LS-DYNA ice and other debris impacts onto RCC full scale panels and impacts onto smaller test RCC panels. Models shall be correlated with test data.

H. The Contractor shall investigate using LS-DYNA solid elements to model RCC flat panels.

I. The Contractor shall investigate using User Subroutine Material Model for RCC as specified by the customer.

J. The Contractor shall generate finite element models and perform the required analyses to simulate material tests currently in progress at GRC or LaRC on the RCC panels. This effort may be extended to other materials/material systems and future test efforts. These analyses shall be performed primarily with LS-DYNA and LS-Prepost. Other codes such as ABAQUS and NASTRAN may be necessary. Models shall be generated in such a way that they will be compatible with existing pre- and post-processing software (e. g., PATRAN).

2.1.1 (NOC) Deliverables and Schedule (Required):

(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 correlation
(4) PATRAN 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

2.1.2 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 model development and/or analysis easier, more accurate, or more efficient.

(2) Superior documentation of work.

(3) Fidelity and accuracy of Test/Analysis.

[R1]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:

Test specimens

Test specimen instrumentation

Access to NASA specialized structural analysis software, including MSC/NASTRAN, MSC/PATRAN and MSC/DYTRAN, LS-DYNA, LS-Post, etc.

Computer CPU time for structural modeling and analyses

Office space

4. Other Essential Information:

Dissemination of significant results through an international forum along with associated travel may be required as appropriate.

5. Security Clearance: None

6. Period of Performance:

Planned start date: [R1]***January 25, 2007*** Completion date: [R1]~~December 31, 2007~~ ***April 30, 2008***

7. NASA Task Management:

Technical Monitor (Required): Ed Fasanella

M/S: 495 Phone: 757-864-4345

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 4

TASK ORDER NUMBER: 036D3-NNL07AM46T Revision: 1 Change: 0 Date: December 3, 2007
Title: Real-Time Software Development for SAFETI Lab

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 06D3T)
Research conducted under the Integrated Vehicle Health Management Program and the Aviation Safety Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. As part of the Airborne Systems Research capability, which is being cultivated to support NASA's Aviation Safety Program, the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory is being developed to provide the capability to integrate variable fidelity aircraft simulation with 'in-the-loop' fault/error testing of avionics hardware. This research capability will be utilized to promote the validation of developed advanced technologies under adverse conditions, and to processes for compliance demonstrations of complex integrated critical systems to certification requirements for operation in electromagnetic environments (EME), such as lightning and High Intensity Radiated Fields, R2to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions. This task provides engineering support in these areas for research conducted under these programs.

Revision 1 (12/3/07): Extends the period of performance 3 months to March 31, 2008 in continuation of NASA's support with some clarification and updated schedule (Subtask 4), updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n with clarified requirements (see [R1] below).

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

2.1 Software Applications Required for Investigations: The Contractor shall develop, update and maintain software applications required for investigations utilizing the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) laboratory to find solutions to critical problems involving design, development, verification and certification of complex interconnected fault tolerant digital avionics systems. This work includes an application that integrates operation and control of a closed-loop, real-time flight simulation with various avionics hardware subsystems including (i) the Honeywell Distributed Flight Controls System Testbed (DFCS), (ii) the Honeywell Recoverable Computer System (RCS), (iii) Honeywell MD-10 cockpit avionics subsystems, (iv) the Honeywell Versatile Integrated Avionics (VIA) system, and other selected hardware subsystems including VME-based analog and discrete interface signals, PC-based Out-The-Window (OTW) graphics display systems and SCRAMNet network. The Contractor shall verify all systems integration software for accuracy and fidelity after modifications are made. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.1.1 Deliverables and Schedule (Required): Software required for integration and real-time, closed-loop operation of the following components (i) MD-10 simulation, (ii) the Honeywell DFCS Hardware, (iii) the Honeywell VIA system, (iv) the Out-The-Window video graphics system, (v) the VME-based analog and discrete I/O concentrator, and (vi) the SCRAMNet shared-memory network. *Ongoing.*

2.1.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) Integration and operations software demonstrated to update SCRAMNet memory with specified ARINC 429 receive/transmit parameters.
Exceeds: Out-The-Window video graphics system demonstrated in Vehicle Emulation Lab's (VEL) cockpit.

2.2 SCRAMNet Data Distribution Applications: The Contractor shall design, develop and maintain, real-time, data distribution applications, utilizing existing SCRAMNet network systems, supporting linking SAFETI Lab to internal and external research support facilities. The Contractor shall verify all data display software for accuracy and fidelity after development. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.2.1 Deliverables and Schedule (Required): Software required for the integration and display, in SAFETI Lab, of SCRAMNet network data collected from other NASA LaRC facilities and external facilities. *Ongoing.*

2.2.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) SCRAMNet data shall be received in SAFETI Lab from one NASA LaRC facility linked to B1220 with fiber optic cable, and displayed on SAFETI lab computer systems. SAFETI Lab data shall be transmitted, via SCRAMNet, to one NASA LaRC facility linked to B1220 with fiber optic cable.
Exceeds: Real-time (data transfer latency no greater than 250 ms), duplex data transfer between SAFETI lab and a facility external to NASA LaRC shall be demonstrated

2.3 Satellite Communications Systems Data Distribution Applications: The Contractor shall design, develop and maintain, data distribution applications, utilizing existing SAFETI Lab Satellite Communications Systems hardware. The Contractor shall develop and demonstrate software required for data, voice and video transfer to and from SAFETI Lab via SAFETI Lab satellite communications system hardware. The Contractor shall verify all simulation software for accuracy and fidelity after installation is completed. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

2.3.1 Deliverables and Schedule (Required): Software required for the integration and display, in SAFETI Lab, of data, voice and video transferred to and from SAFETI Lab via the SAFETI Lab satellite communications system hardware. *Ongoing*

2.3.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) Demonstrate reception, in SAFETI Lab, of test data transferred from

the SAFETI Lab satellite communications system.
Exceeds: Demonstrate reception, in SAFETI Lab, of test data, voice and video transferred from the SAFETI Lab satellite communications system.

2.4 Documentation and Tutorial Information: The Contractor shall provide documentation and tutorial information on all software applications developed for SAFETI Lab.

2.4.1 Deliverables and Schedule (Required): Written document with diagrams of hardware/software configuration, interface requirements, and data collection protocol. *Ongoing.*

2.4.2 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
Meets: (Satisfactory Effort) Delivery of [R1]***mutually agreed upon*** documents/tutorials [R1]~~12/31/06~~ ***3/31/08***.
Exceeds: Timely delivery with suggestions or solutions for system improvement.

[R1]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: Computer equipment, hardware, software, and equipment associated with the Vehicle Emulation Lab and the SAFETI Lab, and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work shall be performed in NASA Langley Building 1220 on a non-interference basis.

4. Other Essential Information: Manuals, schematics, technical reports, and papers will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.

5. Security Clearance: Security clearance is not required.

6. Period of Performance:

Planned start date: [R1]***January 25, 2007*** Completion date: [R1]~~December 31, 2007~~ ***March 31, 2008***

7. NASA Task Management:

Technical Monitor (Required): **Roger M. Bailey**
M/S: 130 Phone: 757-864-2007

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

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TASK ORDER NUMBER: 037D3-NNL07AM47T Revision: 1 Change: 0 Date: May 14, 2007

Title: Advanced Model Instrumentation System Development

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 06RBG)
This task includes fabrication, characterization, and application of MEMS (MicroElectroMechanical Systems) and NEMS (NanoElectroMechanical Systems) based devices such as sensors, actuators, carbon nanotube yarn and sheet multifunctional devices, presentations of findings at various technical conferences such as CANEUS and ASME, and LabView programming and implementation of the program for measurement systems in laboratory in Room 124 in B-1200.

Revision 1 (5/14/07): Shortens the period of performance seven months to June 1, 2007 due to NASA funding/programmatic constraints, adjusts deliverables and schedule accordingly, and updates the initial task order start date to January 25, 2007 (see R1 below).

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

2.1 The Contractor shall characterize MEMS based sensor and actuator systems in LaRC facilities. The systems consist of a MEMS device, a data acquisition, and control board. In particular, the Contractor shall characterize the MEMS sensors and test the performance of the sensors in LaRC facilities. Requirements for the sensor system characterization and evaluation efforts are:

a. Integration of the Government furnished actuators and actuation control software developed for transonic shock mitigation active bump skins at a LaRC Facility.
b. Command and control characteristics of the actuator system with repeatability data.
c. Calibration of actuator system with the control software in a PC / workstation environment.

Also the Contractor shall characterize NEMS based device system in a laboratory. The system consists of NEMS or MEMS devices, a data acquisition and control board, and a host computer. Requirements for the NEMS/ MEMS device system characterization efforts are:

d. Integration of the Government furnished NEMS/MEMS device system in a LaRC laboratory.
e. Characterization of the NEMS/MEMS device system over a temperature range from 10 degree C to 45 degree C.
f. Repeatability evaluation of the NEMS/MEMS devices in a LaRC laboratory.

2.1.1 Deliverables and Schedule (Required):

1. Informal written report of a laboratory based device characterization - *5 months after task start*
2. ~~[R1]Report on the evaluation results of the NEMS/MEMS device performance data - *10 months after task start*~~
3. Informal report about the sensor long term stability over a period of 30 days. ***June 1, 2007***
4. ~~[R1]Demonstration of LabView measurement programs and condensed version of report describing the operational procedures. *December 31, 2007*~~
5. [R1]***Final report summarizing work to date – June 1, 2007***

The reports shall include all of the following laboratory and tunnel evaluation requirements:

- System Integration - Integration and operation of government furnished MEMS/NEMS Systems in Room 124, B-1200.
- Sensor Characterization – Determine sensor response characteristics in a LaRC

laboratory and a wind tunnel. MEMS Sensor Repeatability Evaluation - Test data of temperature corrected voltage outputs from the sensors

- Results of two 30-day period MEMS/NEMS device stability tests with the two tests separated by a minimum of 30 days and analysis of sensor long-term stability.

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

Meets: All measurements within 15% accuracy of known values with deliverables on time.

Exceeds: No measurements deviating from known values by more than 10% with deliverables provided one month early.

2.2 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.

2.2.1 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: Laboratory and tunnel facilities in B-1200 and B-1242 that includes a set of actuator and sensor clusters, associated data acquisition and testing systems, and necessary parts and components for the completion of the task.

4. Other Essential Information: Conference travel and paper authorship requirements TBD.

5. Security Clearance: No security clearance is required for this task.

6. Period of Performance:

Planned start date: R1 ***January 25, 2007*** Completion date: R1 ~~December 31, 2007~~ ***June 1, 2007***

7. NASA Task Management:

Technical Monitor (Required): Seun K. Kahng

M/S: 493 Phone: 757-864-7553

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 2

TASK ORDER NUMBER: 038D3-NNL07AM48T Revision: 3 Change: 0 Date: October 30, 2008
Title: [R3]***AMPB*** Graphics Support

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01RCA)
The objective of this task is the support of research and technology development of advanced materials for aerospace applications.
Revision 1 (10/10/07): Extends the period of performance 9 months to September 30, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and clarifies/updates other requirements (see [R1] below).
Revision 2 (4/15/08): Extends the period of performance 3 months to December 31, 2008 in continuation of NASA's support with updated requirements, GFI, and task title (see [R2]).
Revision 3 (10/30/08): Extends the period of performance 3 months to March 31, 2009 in continuation of NASA's support with updated requirements, GFI, and task title. These changes reflect anticipated NASA funding limited to previously obligated amounts (see [R3] above and below).

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

*****Begin [R3] block descope*****

2.1 Synthesis and Characterization:
The Contractor shall provide graphics support as necessary in the creation of technical slides, figures and brochures for AMPB (up to 10 per month.)
The Contractor shall perform [R1>]updates of the database[<R1] of non-ODIN computer systems for AMPB (average one [R1]update per week.)
[R2>]The Contractor shall create and maintain an informational website for AMPB (Advanced Materials and Processing Branch), which shall be periodically updated (average one update per week.)[<R2]

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):
For each graphics request, the Contractor shall provide the completed graphs or slides within three working days of the work request.
A [R1]monthly report shall be submitted detailing all [R2]website administration activities and status of [R2>]systems database[<R2].

2.1.3 Performance Metrics/Standards (Required - Meets, Exceeds): (See "System and Software Metrics for Performance-Based Contracting")
MEETS:
Efficiency (time to complete, with complexity and competing requests accounted for)
Work requests completed ahead of schedule
Cost

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

*****End [R3]block descope*****

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.

TASK ORDER NUMBER: 038D3-NNL07AM48T Revision: 3 Change: 0 Date: October 30, 2008

Title: R3 ***AMPB*** Graphics Support

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:

R2>In addition to ODIN supplied workstation, Contractor will have access to specialized software, such as ChemDraw, a color printer, a scanner and networked hard drives.<R2 R3>***Note: GFI deletions are consistent with those indicated above.***<R3

4. Other Essential Information:

All R3***graphics*** materials will be Government property and shall be used exclusively in the R3***Supersonics***, RTF, Hypersonics, AvSec and other NASA programs.

5. Security Clearance: None

6. Period of Performance:

Planned start date:	R1 January 24, 2007	Completion date:	R1 ~~December 31, 2007~~ R2 ~~September 30, 2008~~ R3 ~~December 31, 2008~~ ***March 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): James F. Dezern

M/S: 226 Phone: 757-864-4263

Other POC (Optional):

M/S: Phone:

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TASK ORDER NUMBER: 001E1-NNL07AM49T Revision: 2 Change: 0 Date: August 14, 2008	
Title: **External Business and Direct Project Resource Execution**	

1. Purpose, Objective, or Background (Optional) (Follow-on to Sub-Task 4 of SAMS task order 02OJ)

Revision 1 (6/20/07): Extends the period of performance one year in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n (see [R1] below).
Revision 2 (8/14/08): Extends the period of performance one year to December 31, 2009 in continuation of NASA's support and documents an earlier change in Technical Monitor addition (see [R2] 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 project area of support becomes defined, the Technical Monitor will provide clarification to the Contractor.

2.1 (Requirement/subtask number one):

The Contractor shall provide external business and direct project resource planning, execution, and analysis to the Aeronautics Research Directorate (ARD). The Contractor shall provide resource planning, data analysis, and problem resolution for assigned project areas. The Contractor shall facilitate and manage all resources related to ARD external/reimbursable projects and activities. The Contractor shall provide process improvement recommendations to the NASA Technical Monitor.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

a. A report of new and ongoing ARD external business/reimbursable activities to include project sponsor, technical point of contact, activity name, total dollar value, facility/lab requirements and commitment, obligation, and cost stats. The report summarizing ARD external business activities shall be submitted quarterly.

b. A report of existing resource plans vs. actuals for identified direct project(s). Reports shall include, but are not limited to, workforce, direct funds, program authority, purchase requisitions and orders, fabrication, and other service activity requirements. This report summarizing direct project resource status shall be submitted to the NASA project manager as requested.

c. Meetings with the NASA task monitor 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. These meetings shall occur quarterly.

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

Meets: All deliverables on schedule as described in 2.1.2 above.

Exceeds: Contractor performance "Meets" plus any of the following metrics occurs:

a. Reports summarizing ARD external business activities submitted monthly.
b. Reports summarizing direct project resource status submitted to the NASA project manager by the 10th of each month.
c. Meetings to discuss proposed improvements and progress on current improvements occur monthly with the task monitor or other designated NASA manager.

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:

4. Other Essential Information:

5. Security Clearance:

6. Period of Performance:

Planned start date: R1 January 25, 2007 Completion date: R1 ~~December 31, 2007~~
R2 ~~December 31, 2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): R2 ***James R. Burley***
M/S: 254 Phone: 864-***2008***

Technical Monitor (Required): John A. Costulis
M/S: 254 Phone: 864-7174

Other POC (Optional):
M/S: Phone: 864-

TASK ORDER NUMBER: 001E4-NNL07AM50T Revision: 3 Change: 0 Date: December 18, 2008.

Title: **Systems Analysis Support for Hypersonics, Exploration, and Related Projects**

1. Purpose, Objective, or Background (Optional) (VAB requires support for this effort in several discipline areas including hypersonic vehicle propulsion, aerodynamics and aerothermodynamics and has acquired these services previously under the 38RAA task order of the SAMS contract NAS1-00135. These skills currently exist within the Swales group that supports the Hypersonic Airbreathing Propulsion Branch under the SAMS 01OCB task order. This need for support is currently expected to be fairly constant in the 3-4 WYE range for the next five fiscal years (FY07-11), although specific task details will likely only be known up to a year in advance.)

The Vehicle Analysis Branch (VAB) in the Systems Analysis and Concepts Directorate (SACD) is actively involved in supporting the newly formed Hypersonics Project within the Fundamental Aeronautics Program in the Aeronautics Research Mission Directorate. As part of a multi-center team, VAB supplies systems analysis support to the Hypersonics Project. This support comes in several forms including conceptual system design, analysis, and optimization, technology assessment, and systems analysis related design environments and analytical tool development, verification and validation.

In addition to specifically supporting the Hypersonics Project at the funding levels mentioned, VAB may from time to time (and as additional funding becomes available) require additional support (in the same discipline areas mentioned previously) to supplement workforce on other projects within the branch. Such projects may include CEV, CLV and related Exploration projects, or other projects with external customers (DOD/Air Force). As these new requirements arise, new tasks or sub-tasks will be written to address each need.

Revision 1 (6/25/07): Extends the period of performance nine months to September 30, 2008 in continuation of NASA's support requirements and re-designates safety and organization subtask as 2.n (see [R1] below).

Change 1 (11/20/07): Adds NOC N001 clarification as a requirement of Subtask 2.2 (see [R1.1] below).

Revision 2 (7/7/08): Extends the period of performance 12 months to September 30, 2009 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R2] below).

Revision 3 (12/18/08): Adds requirements as new element 2.4 (see [R3] 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. Two Stage to Orbit Launch Vehicle Design and Analysis (NOC):

2.1.1. Work Description

The Contractor shall provide support to VAB in multiple disciplines on the conceptual design and analysis of Two-Stage-to-Orbit (TSTO) hypersonic airbreathing launch vehicles in support of the Hypersonics Project. Requirements will include airbreathing flowpath design, performance analysis, and database development, aerodynamic and aerothermodynamic database and loads model development, computational fluid dynamics analysis, and vehicle and engine thermal and thermal protection system (TPS) analysis. This work will not only include the design, analysis, and optimization of such systems, but tasks associated with assessing the impact of alternate technologies on the system figures of merit.

The Contractor staff shall work as members of an integrated, multi-center team which may require communication and interfacing with personnel at other NASA centers and/or industry locations. Participation in periodic meetings and telecons is required. Much of the information and data related to these concepts is at a minimum subject to ITAR and some may be classified SECRET. Specifically,

2.1.1.1. The Contractor shall generate aerodynamic and aerothermal loads information using engineering tools and methods (e.g. APAS, SHABP) for the mated and unmated configurations of the TSTO concepts under study. This work supports the development of the overall aerodynamic and aerothermal loads databases.

2.1.1.2. The Contractor shall generate aerodynamic and aerothermal loads information using high fidelity tools and methods (e.g. Vulcan, USM3D) for the mated and unmated configurations of the TSTO concepts under study. This work supports the development of the overall aerodynamic and aerothermal loads databases.

2.1.1.3. The Contractor shall assist in the design and optimization of the highspeed airbreathing flowpath.

2.1.1.4. The Contractor shall generate propulsion-related flowfield information using high fidelity tools and methods (e.g. Vulcan, SHIP) sufficient to support the development of the highspeed propulsion database (2.1.1.5).

2.1.1.5. The Contractor shall develop the propulsion database associated with the highspeed airbreathing flowpath.

2.1.1.6. The Contractor shall support the vehicle thermal analysis and development of thermal protection system design solutions for the entire system.

2.1.1.7. The Contractor shall support the assessment of the impact of alternate technologies on the baseline TSTO concept. This assessment will likely include alternate materials and/or TPS concepts that will require a new aerothermal database and new thermal analysis.

2.1.2. Milestones (Optional):

2.1.3. Deliverables and Schedule (Required):

2.1.3.1. Document all significant findings for the aerodynamic and aerothermal loads information using engineering tools and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.1.3.2. Document all significant findings for the aerodynamic and aerothermal loads information using high fidelity methods and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.1.3.3. Document all significant findings for the design and optimization of the highspeed airbreathing flowpath and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.1.3.4. Document all significant findings for the propulsion-related flowfield information using high fidelity tools and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.1.3.5. Document all significant findings for the development of the propulsion database associated with the highspeed airbreathing flowpath and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.1.3.6. Document all significant findings for the vehicle thermal analysis and thermal protection system design solutions and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.1.3.7. Document all significant findings for the assessment of alternate technologies and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

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

The 2.1.1.1-2.1.1.7 sub-tasks will be considered to meet the minimum acceptable level if:

a) The scheduled deliverables are met on time and within the estimated cost.
b) The results are documented in a final report and/or meeting papers.
c) Solutions and analyses are consistent with standard NASA/Industry procedures and processes.

These sub-tasks will be considered to have exceeded the minimum requirements if:

a) The effort is performed such that all of the deliverables are met at a reduced cost or ahead of schedule.
b) Results are archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

2.2. Fresh-FX Sounding Rocket Flight Tests:

2.2.1. Work Description:

The Contractor shall provide support to VAB in multiple disciplines on the design and analysis of the Fresh-FX sounding rocket flight tests. NASA will collaborate with the Air Force on two of the Fresh-FX flight tests which utilize multi-stage sounding rockets to propel small hypersonic propulsion experiments to their appropriate test conditions. The Contractor shall assist VAB in the analysis of the sounding rocket performance by providing aerodynamic and aerothermodynamic analysis of each of the flight configurations. Nominally, there will be three flight configurations for each test: 1) full launch stack consisting of two solid rocket stages with a shroud covering the payload, 2) second stage solid motor with shroud attached, and 3) second stage solid motor with shroud removed and propulsion experiment exposed.

The Contractor staff shall work as members of an integrated team which may require communication and interfacing with personnel at other government facilities. Participation in periodic meetings and telecons is required. Some of the information and data related to these flights will be subject to ITAR. Specifically,

2.2.1.1. The Contractor shall generate aerodynamic and aerothermal loads information using engineering tools and methods (e.g. APAS, SHABP) for the mated and unmated configurations of the TSTO concepts under study. This work supports the development of the overall aerodynamic and aerothermal loads databases.

2.2.1.2. The Contractor shall generate aerodynamic and aerothermal loads information using high fidelity tools and methods (e.g. Vulcan, USM3D) for the mated and unmated configurations of the TSTO concepts under study. This work supports the development of the overall aerodynamic and aerothermal loads databases.

2.2.1.3. The Contractor shall support the analysis and design of thermal protection system solutions for the entire system.

2.2.1.4. [R1.1]The Contractor shall apply SRGULL to generate propulsion datasets and utilize high fidelity tools and methods such as VULCAN to perform flowpath and operability assessment analysis.

2.2.2. Milestones (Optional):

2.2.3. Deliverables and Schedule (Required):

2.2.3.1. Document all significant findings for the aerodynamic and aerothermal loads information using engineering tools and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.2.3.2. Document all significant findings for the aerodynamic and aerothermal loads information using high fidelity methods and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

2.2.3.3. Document all significant findings for the analysis and design of the thermal protection system and provide electronic files of technical data generated. Documentation due 30 days after completion of technical subtask.

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

The 2.2.1.1-2.2.1.3 sub-tasks will be considered to meet the minimum acceptable level if:

a) The scheduled deliverables are met on time and within the estimated cost.
b) The results are documented in a final report and/or meeting papers.
c) Solutions and analyses are consistent with standard NASA/Industry procedures and processes.

These sub-tasks will be considered to have exceeded the minimum requirements if:

a) The effort is performed such that all of the deliverables are met at a reduced cost or ahead of schedule.
b) Results are archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

2.3. Integrated Design Environment and Analytical Tool Development, Verification, and Validation: (NOC)

2.3.1. Work Description:

The Contractor shall provide support to VAB for the development of an integrated design and analysis environment as well as individual systems analysis related analytical tool development, verification, and validation. VAB is in the process of developing an integrated environment (called AdVISE) using the Adaptive Modeling Language (AML) from Technosoft, Inc. The Contractor shall assist VAB in the integration and development of propulsion, aerodynamic and aerothermodynamic tools and processes within the AdVISE environment. The Contractor may also be asked to evaluate and/or modify individual analytical tools in these discipline areas.

The Contractor may be required to work with personnel at other government facilities and/or industry personnel. Participation in periodic meetings and telecons is required. Specifically,

2.3.1.1. The Contractor shall create, modify, and/or evaluate software processes and methods for various airbreathing and rocket based launch vehicles within the AdVISE environment.

2.3.1.2. The Contractor shall create, modify, and/or evaluate individual analytical tools and methods in the propulsion, aerodynamic, and aerothermodynamic disciplines.

2.3.2. Milestones (Optional):

2.3.3. Deliverables and Schedule (Required):

2.3.3.1. Document all significant findings for the creation, modification, and evaluation of software processes and methods within the AdVISE environment. If a tool or method has been created or modified, the Contractor shall provide a demonstration of the enhanced capability. Documentation and demonstration due 30 days after completion of technical subtask.

2.3.3.2. Document all significant findings for the creation, modification, and evaluation of individual discipline tools and methods. If a tool or method has been created or modified, the Contractor shall provide a demonstration of the enhanced capability. Documentation and demonstration due 30 days after completion of technical subtask.

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

The 2.3.1.1 and 2.3.1.2 sub-tasks will be considered to meet the minimum acceptable level if:

a) The scheduled deliverables are met on time and within the estimated cost.
b) The results are documented in a final report and/or meeting papers.
c) Solutions and analyses are consistent with standard NASA/Industry procedures and processes.

These sub-tasks will be considered to have exceeded the minimum requirements if:

a) The effort is performed such that all of the deliverables are met at a reduced cost or ahead of schedule.
b) Results are archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

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

2.4 Structural Analysis Support for the Vehicle Analysis Branch (VAB):

2.4.1 Work Description:

The Contractor shall provide structural analysis for Hypersonic, Exploration and Related Projects in the VAB. 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.

2.4.2 Milestones (Optional):

2.4.3 Deliverables and Schedule (Required):

2.4.3.2 Analysis models in electronic format, including model file, applicable results files, and any subsidiary files necessary to run the model. Due 30 days after completion of technical subtask.

2.4.3.2 Analysis reports documenting analysis work, model development, assumptions, requirements, cases run, results, issues and solutions. Documentation due 30 days after completion of technical subtask.

2.4.3.3 Charts, tables, documents and electronic media documenting Contractor methods and results. Documentation due 30 days after completion of technical subtask.

2.4.3.4 Source code developed to automate running a model, analyzing results, or to support any VAB task. Documentation due 30 days after completion of technical subtask.

2.4.4 Performance Metrics/Standards (Required – Meets, Exceeds):

The 2.4.3.1-2.4.3.4 sub-tasks will be considered to meet the minimum acceptable level if:

d) The scheduled deliverables are met on time and within the estimated cost.
e) The results are documented in a final report and/or meeting papers.
f) Solutions and analyses are consistent with standard NASA/Industry procedures and processes.

These sub-tasks will be considered to have exceeded the minimum requirements if:

c) The effort is performed such that all of the deliverables are met at a reduced cost or ahead of schedule.
d) Results are archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

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

2.n Working Environment Safety and Organization:

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

TASK ORDER NUMBER: 001E4-NNL07AM50T Revision: 3 Change: 0 Date: December 18, 2008.

Title: **Systems Analysis Support for Hypersonics, Exploration, and Related Projects**

4. Other Essential Information:

5. Security Clearance: Secret clearance may be required.

6. Period of Performance:

Planned start date:	1/25/07	Completion date:	R1 ~~12/31/07~~ R2 ~~9/30/08~~ 9/30/09

7. NASA Task Management:

Technical Monitor (Required): Jeff Robinson
M/S: 451 Phone: 43782

Other POC (Optional): Chuck Leonard
M/S: 451 Phone: 48032

TASK ORDER NUMBER: 002E4-NNL07AM51T Revision: 5 Change: 0 Date: June 9, 2008

Title: **Advanced Concepts Systems Analysis, Vehicle Design, Technology Studies, and Methods Development**

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. (Reference current task: 36RAC/ NAS1-00135)

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) and the Joint Planning and Development Office (JPDO) in their mission to transform the air space system with the Next Generation Air Transportation System (NGATS) vision. The NGATS 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 NGATS 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.

Revision 1 (1/26/07): Adds requirements as new Subtask 2.6 and changes Working Environment Subtask to a generic "n" designation (see [R1] below).
Revision 2 (4/06/07): Discontinues Subtasks 2.1 and 2.2, for continuation under new task orders 006E4NNL07AM86T and 008E4NNL07AM88T, respectively; updates/clarifies deliverable 2.6.2 b); and documents earlier Technical Monitor change (see [R2] below).
Revision 3 (5/14/07): Adds structures analysis requirements as new Subtask 2.7, updates the initial task order start date to January 25, 2007, and recognizes the need for adding work by clarification of requirements (see [R3] below).
Revision 4 (11/21/07): Extends the period of performance 9 months to September 30, 2008 in continuation of NASA's support, clarifies Working Environment Subtask 2.n, updates the schedule of Subtask 2.7, and adds requirements as new Subtasks 2.8-2.11 (see [R4] below).

Technical Direction 1 (3-6-2008): Adds potential travel/training requirements and data rights clarification to Section 4 (see [TD1] below).
Revision 5 (6/9/08): Extends the period of performance 12 months to September 30, 2009 in continuation of NASA's support, adds requirements as new Subtasks 2.12-2.15, includes various corrections/clarifications, and updates the POC data (see [R5] below).

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

[R3>]Contract paragraph **H.8 ELECTRONIC NOTICES OF CLARIFICATIONS (NOCs)** applies to this task order. See NOC designated item(s) and description below.[<R3]

2.1 (Requirement/subtask number one): [R2](Discontinued here for continuation under new task order 006E4NNL07AM86T) 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:….

2.2 (Requirement/subtask number two): [R2](Discontinued here for continuation under new task order 008E4NNL07AM88T) These tasks are in support of the Supersonics (SUP) Program in the Fundamental Aeronautics Program….

2.3 (Requirement/subtask number three):
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 NGATS.

b) 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 NGATS.

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 NGATS.

d) 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.

2.3.1 Milestones (Optional):

2.3.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date

b) Commercial airline demand studies with sensitivities that result from NGATS meeting its goals of time and efficiency. Due by: September 30, 2007

c) On-demand air-taxi demand studies with sensitivities that result from of NGATS meeting its goals of time and efficiency. Due by: R3 ~~September 30, 2007~~ December 31, 2007

d) Demand studies for commercial airlines including the additions of new potential hubs, new commercial airports and satellite airports in TRACONS to model new NGASTS concepts. Due by: R3 ~~September 30, 2007~~ 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 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).

2.4 (Requirement/subtask number four):
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) 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.

2.4.1 Milestones (Optional):

2.4.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Commercial airline airspace simulations with sensitivities that result from of NGATS meeting its goals of time and efficiency. Due by: R3 ~~September 30, 2007~~ December 31, 2007

c) On-demand air-taxi demand airspace simulations with sensitivities that result from of NGATS meeting its goals of time and efficiency. Due by: R3 ~~September 30, 2007~~ December 31, 2007

d) Airspace simulations studies for commercial airlines including the additions of new potential hubs, new commercial airports and satellite airports in TRACONS to model new NGATS concepts. Due by: R3 ~~September 30, 2007~~ December 31, 2007

2.4.3 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).

2.5 (Requirement/subtask number five):

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.

c) Enhancements and development of the airspace simulation programs to include the modeling of CNS, Airborne Separation and Assurance System, safety assessments and other capabilities as needed.

d) Enhancements and development of the Legacy General Aviation demand prediction program.

2.5.1 Milestones (Optional):

2.5.2 Deliverables and Schedule (Required):

a) TSAM cost model enhancements on the under utilized airline routes that are not included in the DB1B data. Due by: [R3]~~March 31, 2007~~ December 31, 2007

b) Enhancement of the ACES airspace simulation to output delay metrics for individual classes of aircraft, such as Very Light Jets and commercial airlines. Due by: September 30, 2007

c) Enhancements and upgrades to the Legacy General Aviation demand model to include a larger airport set and updated demographics for prediction. Due by: [R3]~~March 31, 2007~~ December 31, 2007

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 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

2.6(Requirement/subtask number six):

The Contractor shall support the Aviation Safety (AvSafe) Program, Airspace Systems Program (ASP) 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 and Airspace Systems Program technologies using the ASAB's SAS software.

b) Mappings of FAR parts 121 and 135 fatal events to CAST accident categories.

c) 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.

d) Regression analyses of historical aviation accident, incident and or/ operational data to identify parameters for simulations of NGATS operational improvements using the ASAB's SAS software.

e) SAS data and text mining of historical aviation accident, incident and or/ operational data to validate the output of ASAB safety and airspace related operations research (e.g., simulation, decision support) models.

2.6.1 Milestones (Optional):

2.6.2 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 R2>and/or models of ~~NGATS operational improvements~~ Aviation Safety, Airspace Systems of JPDO Technologies<R2. Due by: April 30 , 2007

c) Report containing descriptive statistics, summary and graphical representation of aviation safety or airspace systems related data regression analysis results. Due by: September 30, 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

2.6.3 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 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 R3 block addition

2.7 (Requirement/subtask number seven)

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 R4 ~~December 31, 2007~~ September 30, 2008

End R3 block addition

Begin R4 block addition

2.8 (Requirement/subtask number R5 ***eight***)

The objective of this task is to create an integrated suite of tools accessed via a R5***graphic user interface*** (GUI) to enable a non-specialist (but trained) user to create future flight schedules for various categories of air traffic based on TSAM demand projections. The future flight schedule will be generated from a baseline which can either be processed R5***Enhanced Traffic Management System*** (ETMS) recorded traffic or R5***Official Airline Guide*** (OAG) schedules.

Demand projection data output from TSAM will be in a format, which is directly input into the schedule generation tools without requiring hand re-formatting/editing. Output from the schedule generation tools will consist of flight data sets in various formats suitable for input into air traffic simulations. In addition data useful for diagnosis/ analysis will be output.

The GUI will serve as a front end to generate input data files in ascii text format, to facilitate batch operation and portability. A comprehensive users guide will be written.

Approach

A framework is required which uses a class library, containing common useful data structures and routines to build a main program for a specific task. This class library will contain classes, which are useful not only for demand/ schedule generation but other applications, such as data extraction and analysis. Existing codes can serve as a starting point. Many useful data structures and routines can be extracted from existing code, so this is not a complete re-write. Also need a data-library which could simply be a collection of text files but might be an actual database to contain airports info, etc

Air traffic should be divided into categories and treated separately. These are:

- Domestic
    - Commercial
    - Cargo
    - Legacy GA
    - VLJ
    - Military (not generally used)
- International to/from U.S.
    - Commercial
    - Cargo

A separate main program will be written to generate each category of traffic.

Milestones (Optional):

Deliverables and Schedule (Required):

Deliverables:

- Re-done demand translator and schedule generator code.
- Flight demand schedules for Commercial, Legacy GA and International Commercial flights

for 2X, 3X and 2025.
- Monthly progress reports.
- A final users guide documenting the flight schedule generator algorithms and use and execution of code.

Schedule:
All work is to be completed by September 30, 2008

2.9 (Requirement/subtask number R5 ***nine***):
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 NGATS.

b) 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 NGATS.

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 NGATS.

d) 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.

2.9.1 Milestones (Optional):

2.9.2 Deliverables and Schedule (Required):
a) Monthly status reports of results to date

b) Commercial airline demand studies with sensitivities that result from NGATS meeting its goals of time and efficiency. Due by: September 30, 2008

c) On-demand air-taxi demand studies with sensitivities that result from of NGATS meeting its goals of time and efficiency. Due by: September 30, 2008

d) Demand studies for commercial airlines including the additions of new potential hubs, new commercial airports and satellite airports in TRACONS to model new NGASTS concepts. Due by: September 30, 2008

2.9.3 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).

2.10 (Requirement/subtask number [R5]***ten***):
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.

2.10.1 Milestones (Optional):

2.10.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Commercial airline airspace simulations with sensitivities that result from of NGATS meeting its goals of time and efficiency. Due by: September 30, 2008

c) On-demand air-taxi demand airspace simulations with sensitivities that result from of NGATS meeting its goals of time and efficiency. Due by: September 30, 2008

d) Airspace simulations studies for commercial airlines including the additions of new potential hubs, new commercial airports and satellite airports in TRACONS to model new NGATS concepts. Due by: September 30, 2008

2.10.3 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).

2.11 (Requirement/subtask number [R5]***eleven***):

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.

c) Enhancements and development of the airspace simulation programs to include the modeling of

CNS, Airborne Separation and Assurance System, safety assessments and other capabilities as needed.

d) Enhancements and development of the Legacy General Aviation demand prediction program.

2.11.1 Milestones (Optional):

2.11.2 Deliverables and Schedule (Required):

a) TSAM cost model enhancements on the under utilized airline routes that are not included in the DB1B data. Due by: September 30, 2008

b) Enhancement of the ACES airspace simulation to output delay metrics for individual classes of aircraft, such as Very Light Jets and commercial airlines. Due by: September 30, 2008

c) Enhancements and upgrades to the Legacy General Aviation demand model to include a larger airport set and updated demographics for prediction. Due by: September 30, 2008

2.11.3 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 R4 block addition

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

2.12 (Requirement/subtask number twelve)
The objective of this task is to *finalize* an integrated suite of tools accessed via a GUI to enable a non-specialist (but trained) user to create future flight schedules for various categories of air traffic based on TSAM demand projections. The future flight schedule shall be able to be generated from a baseline which can either be processed ETMS recorded traffic or OAG schedules. This suite of tools shall be able to generate flight data sets based upon user specified assumptions such as basic scaling, fleet mix change through aircraft consolidation, fleet mix change through direct point-to-point routing. Additional features shall allow the flight schedules to be generated with either route-by-route growth factors or using the Fratar algorithm for comparison with other flight demand generation schemes. In addition, the flight schedule generator shall allow flight schedules to be generated as extrapolations for years past those that can be

generated from TSAM output.

Demand projection data output from TSAM shall be in a format, which is directly input into the schedule generation tools without requiring hand re-formatting/editing. Output from the schedule generation tools shall consist of flight data sets in various formats suitable for input into air traffic simulations. In addition data useful for diagnosis/ analysis shall be output.

The GUI shall serve as a front end to generate input data files in ascii text format, to facilitate batch operation and portability. A comprehensive users guide shall be written.

Approach

A framework is required which uses a class library, containing common useful data structures and routines to build a main program for a specific task. This class library shall contain classes, which are useful not only for demand/ schedule generation but other applications, such as data extraction and analysis. A data-library shall be kept which could simply be a collection of text files but might be an actual database to contain airports info, etc that can be updated when specifics of the NAS change.

Air traffic shall be divided into categories and treated separately. These are:

- Domestic
    - Commercial
    - Cargo
    - Legacy GA
    - VLJ
    - Military (not generally used)
- International to/from U.S.
    - Commercial
    - Cargo

A separate main program shall be written to generate flight schedules for each category of traffic and the suite will be integrated through the GUI.

Milestones (Optional):

Deliverables and Schedule (Required):

Deliverables:

- Demand translator and schedule generator code that can be both run through a GUI or run in command line form.
- Algorithms to grow schedules both by route-by-route growth ratios, and the Fratar algorithm by growth ratios at airports.
- Algorithms that read all necessary input directly from TSAM output files.
- Algorithms that automate the growth of schedules for years past 2030 form the 2025 and 2030

output files.

- Algorithms that consolidate aircraft and up-gauge the fleet mix on high demand routes.
- Algorithms that add direct flights (where demand warrants) and eliminates connecting flights through hubs.
- Algorithms to compute domestic and international revenue passenger miles to compare results with published FAA data and projections.
- Flight schedules written in the FACET airspace simulator input format.
- Monthly progress reports.
- A final users guide documenting the flight schedule generator algorithms, as well as the use and execution of code.

Schedule:

All work is to be completed by June 30, 2009

2.13 (Requirement/subtask number thirteen):

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) *Domestic and international* 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) 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.

d) Study the effects of future economic projections that reflect the current high rise in fuel costs and the resulting effects on the economy and the sensitivities on demand sets.

2.13.1 Milestones (Optional):

2.13.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Domestic and international commercial airline, General Aviation, and on-demand air-taxi demand studies with sensitivities that result from NextGen meeting its goals of time and efficiency. Due by: September 30, 2009

c) Domestic and international commercial airline, General Aviation, and on-demand air-taxi demand studies with sensitivities that result from the recent effects of high fuel costs and its effects on the national economy. Due by: September 30, 2009

2.13.3 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).

2.14 (Requirement/subtask number fourteen);
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 shall 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 shall be conducted calculating the demand for passengers and commercial flights at secondary airports around major hub airports. Then flight simulations shall be conducted quantifying the benefits, or reductions in NAS and airport delays that may occur if this concept is realized. In addition, simulations shall 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 shall be provided by:

a) Airspace simulation studies from state-of-the art airspace simulations such as ACES, FACET, and RAMS.

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 into and not into OEP airports, operations at new commercial airports, and 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.

2.14.1 Milestones (Optional):

2. 14.2 Deliverables and Schedule (Required):

a) Monthly status reports of results to date.

b) Domestic and international commercial airline airspace simulations with sensitivities that result from of NextGen meeting its goals of time and efficiency. Due by: September 30, 2009

c) On-demand air-taxi demand airspace simulations with sensitivities that result from of NextGen meeting its goals of time and efficiency. Due by: September 30, 2009

d) 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: September 30, 2009

2. 14.3 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).

2.15 (Requirement/subtask number fifteen):

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 to output values of metrics from Airspace simulation programs that can be used in ASAB sensitivity studies.

c) Enhancements and development of the airspace simulation programs to include the modeling of CNS, Airborne Separation and Assurance System, safety assessments and other capabilities as needed.

d) Enhancements and development of the Legacy General Aviation demand prediction program to include the latest economics and demographics based upon recent developments in the economy.

2. 15.1 Milestones (Optional):

2. 15.2 Deliverables and Schedule (Required):

a) TSAM cost model enhancements on the under utilized airline routes that are not included in the DB1B data. Due by: June 30, 2009

b) Enhancement of the ACES airspace simulation to output delay metrics for individual classes of aircraft, such as Very Light Jets and commercial airlines on each route or O-D pair. Due by: June 30, 2009

c) Enhancements and upgrades to the Legacy General Aviation demand model to include updated demographics for more accurate predictions. Due by: September 30, 2009

2. 15.3 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 [R5] block addition*****

[R1]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 [R4]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. <u>Government Furnished Items</u>:

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. <u>Other Essential Information:</u>

** 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. <u>Security Clearance</u>:

6. <u>Period of Performance</u>:

Planned start date: [R3]January 25, 2007 — Completion date: [R4]~~December 31, 2007~~ [R5]~~September 30, 2008~~ ***September 30, 2009***

7. NASA Task Management:

<u>Technical Monitor (Required):</u> [R2]**Jeffrey Viken**

M/S: 442 Phone: 757-864-2875

<u>Other POC (Optional):</u>

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 3

TASK ORDER NUMBER: 003E4-NNL07AM52T Revision: 6 Change: 0 Date: May 6, 2009

Title: Technology and Trade Studies For Advanced Aircraft

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 02RAD)

The Advanced Aerospace Concepts Branch conducts systems analysis, trade and experimental studies to determine/ define the requirements and performance characteristics of advanced military aircraft and to determine the high risk/high payoff areas for NASA research. Mission effectiveness, operational considerations and cost models are an integral part of these studies as appropriate. Vehicle concepts will be studied to determine estimates of performance, weight, cost, etc.

Revision 1 (7/3/07): Extends the period of performance two months to January 31, 2008 in continuation of NASA's support requirements, re-designates safety and organization subtask as 2.n, and updates the initial task order start date to January 25, 2007 (see [R1] below).
Revision 2 (11/26/07): Extends the period of performance 10 months to November 28, 2008 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R2] below).
Revision 3 (4/3/08): Adds a specific deliverable to the task for formal documentation of results (see details under separate cover).
Revision 4 (5/19/08): Extends the period of performance 13 months to December 31, 2009 in continuation of NASA's support, adds training requirements, updates travel requirements, and changes the Alternate Technical Monitor (see [R4] below).
Revision 5 (2/19/09): Adds specific deliverables, new vehicle concepts and additional subject matter expertise that will require additional WYE (see [R5] reference below to classified details under separate cover).
Revision 6 (5/06/09): Extends the period of performance 12 months to December 31, 2010 in continuation of NASA's support (see [R6] 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 will participate as part of a team composed of the Contractor, Government technical focal points, and possibly the end-user community.

The Contractor shall conduct trade studies of integrated advanced concept vehicles. Appropriate vehicle performance parameters (range, payload (weight and volume), aerodynamic performance, propulsion concepts, sensors, etc.) will be systematically investigated, theoretically and experimentally, to determine the impact of these parameters on the vehicle characteristics. The Contractor shall develop sets of evaluation metrics, including but not limited to, development risk and cost, procurement cost, life cycle cost, reliability, mission capability, etc., to be used as criteria for assessing or narrowing the number of concepts for further evaluation.

Specific objectives or work elements designated to the Contractor will be further defined in the addendum to the statement of work provided under a separate cover dated [R5]February 18, 2009. This addendum will be provided by the NASA CO. The Contractor shall be fully responsible for developing subtask plans and recommending the appropriate analysis and experimental investigations as defined in the separate addendum.

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

Detailed deliverables and performance metrics are contained in the addendum to the statement of work provided under a separate cover.

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

Meets:

A. On time delivery of required deliverables

B. Professional and concise presentations

C. Timely communication of technical progress. The contractor is encouraged to use informal formats to accomplish this: direct telephone or electronic.

D. Timely communication of issues and concerns which impact successful completion of subtasks.

Exceeds:

A. Identification of alternate design and/or technology integration concepts resulting in significant performance improvements (not incremental, must be greater than 5%).

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

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R2support 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: Office space, computers, telephones, access to equipment in government facilities used by the Advanced Aerospace Systems Branch.

4. Other Essential Information: R4~~Four~~ Eight trips will be required. Two to Washington D.C. and R4~~two~~ six to California.

R4>The Contractor shall participate in appropriate technical conferences/short courses to maintain cognizance of new approaches to aircraft systems analysis and to refresh skills, as needed, to support the requirements of this task.<R4

5. Security Clearance: Due to the nature of the work, the Contractor shall have a Top Secret security clearance and must request the addendum to the Statement of Work through the CO in order to receive it through appropriate NASA channels. Additionally, due to the nature of the proposed work, the Contractor shall perform this task on site (B1251) at the NASA Langley Research Center.

6. Period of Performance:

Planned start date:	[R1]January 25, 2007	Completion date:	[R1]~~November 30, 2007~~ [R2]~~January31, 2008~~ [R4]~~November 28, 2008~~ [R6]~~December 31, 2009~~ ***December 31, 2010***

7. NASA Task Management:

Technical Monitor (Required): Richard F. Catalano

M/S: 411 Phone: 757-864-9603

Alternate Technical Monitor (Optional): [R4]Josue Cruz

M/S: 411 Phone: 757-864-5267

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 4
TASK ORDER NUMBER: 001E5-NNL07AM53T Revision: 5 Change: 0 Date: March 6, 2009	
Title: **FTA Logistics Management**	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01E5B)

The purpose of this task order is to provide logistics support on site at LaRC, Dryden Flight Research Center (DFRC), White Sands Test Facility (WSTF), and White Sands Missile Range (WSMR) for the LaRC Flight Test Article (FTA) Project. This task encompasses the storage, handling, packing, shipment, and set up of specialized Ground Support Equipment (GSE) related to the support of Assembly, Integration, and Test (AIT) activities associated with the integrated Pad Abort and Ascent Abort test articles from LaRC to the initial AIT site (DFRC) and support during the follow-on AIT and launch preparation activities (DFRC, WSTF, and WSMR).

This Contractor support includes the acquisition, shipment, and set up of those items of specialized GSE, hardware, and materials necessary to support AIT activities at LaRC, DFRC, WSTF, and WSMR.

Revision 1 (8/27/07): Adds details of travel requirements, re-designates safety and organization subtask as 2.n, updates the initial task order start date to January 25, 2007 (see [R11] below).
Revision 2 (2/28/08): Extends the period of performance 5 months to September 30, 2008 in continuation of NASA's support requirements, clarifies safety and organization Subtask 2.n, and clarifies the Contractor's role in providing computer resources (see [R2] below).
Revision 3 (9/4/08): Extends the period of performance 3 months to December 31, 2008 in continuation of NASA's support and documents a change in Technical Monitor (see [R3] below).
Revision 4 (11/25/08): Extends the period of performance 3 months to March 31, 2009 in continuation of NASA's support (see [R4] below, Section 6).
Revision 5 (3/6/09): Extends the period of performance 3 months to June 30, 2009 in continuation of NASA's support (see [R5] below, Section 6).

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

2.1 The Contractor shall provide logistics support in coordination with the FTA Logistics Coordinator as outlined below:

- Formulation of schedules necessary to facilitate the timely preparation, shipment, and set up of GSE, hardware, and supplies required to support AIT activities at the various integration, test, and launch sites.
- Identification and acquisition of general and specialized GSE, hardware, and supplies necessary to support all AIT activities.
- Planning for required facility support at the various test locations to ensure that there are adequate utilities available to support tests such as the Pad Abort and Ascent Abort. Facility support will include utilities (electrical power, water, etc.), and equipment movement capabilities (cranes, forklifts, etc.).
- Packing, shipment, and set up of LaRC GSE, Pad Abort and Ascent Abort test articles to the initial AIT locations and support of the same throughout the AIT and launch preparation process for Pad Abort and Ascent Abort. This task will include leading the formulation of procedures necessary for the handling, packing, shipment, and post-shipment set up of the equipment and

hardware as well as that of the Pad Abort and Ascent Abort test articles. This task will also include the logistics required for the packing and transportation of the GSE and flight test article hardware to and the post-arrival set up and implementation of GSE, Pad Abort and Ascent Abort test articles at the initial AIT site, as well as support of such activities throughout the follow-on AIT and launch preparation process.

2.1.1 Milestones (Optional)

2.1.2 Deliverables and Schedule (Required):

- Generation and documentation of procedures necessary for handling, packing, and shipment of Pad Abort and Ascent Abort tests articles and associated GSE from the FTA Project to initial AIT site(s). (FTA Project schedule).
- Generation and maintenance of an inventory record of GSE, hardware, and supplies provided to the various AIT and launch preparation sites. Provide *ad hoc* status reports. (ongoing)
- Maintain records of documentation related to the shipment of hardware, GSE, and supplies to the various AIT locations noted above. (ongoing)
- Provide informal reports of anomalies, workarounds, and concerns in regard to the task items listed above. (ongoing)
- Provide a lessons learned report at project completion.

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

Satisfactory performance (Meets):

- All of the FTA logistics and GSE support activities are executed in a manner such that the FTA Pad Abort and Ascent Abort test articles are delivered and supported as necessary at the AIT and launch sites and that schedules are met. Note: This is not to include any Platform, GSE, or FTA instrument failures outside the FTA Project or Contractor's control (including facility site scheduling delays).
- All of the above mentioned procedures and reports follow the established FTA Project standard format and are delivered as scheduled and accepted with little or minor change post-review by the FTA Project Staff.
- All of the above mentioned procedures are of a high quality in terms of organization, thoroughness, completeness, and readability as determined by FTA Project reviewers.
- All appropriate flight hardware product assurance and clean room policies and plans are followed.

Exceeds performance:

- All of the FTA hardware and GSE setups are executed in an efficient manner such that the FTA Pad Abort and Ascent Abort test articles readiness to proceed with integration is achieved somewhat ahead of the planned initial AIT allotted schedule for doing so. Note that this is not to include any Platform, Launch Vehicle, GSE, or failures outside the FTA Project or Contractor's control (including facility site scheduling delays).
- All of the above mentioned procedures and reports are delivered ahead of the required scheduled time and accepted with little or no changes post-review by the FTA Project reviewers.
- All of the above mentioned procedures and reports are of exceptional quality in terms of organization, thoroughness, completeness, and readability as determined by the FTA Project reviewers.
- Contractor's response to anomaly events and schedules changes is timely and effective as determined by the FTA Project Staff.
- All appropriate flight test article hardware product assurance and safety policies and plans are followed.

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:

1) [R2]~~Access to computers loaded with specialized software as required to perform this task.~~

2) Access to the FTA GSE hardware, FTA interface control documents (ICDs), and FTA Project documentation as required for record keeping and for monitoring the scheduled certification maintenance. The GSE and equipment may also be used on a non-test interference basis for operator training and for the evaluation of new procedures as appropriate. The use of the FTA GSE will be scheduled and coordinated through the FTA Project.

4. Other Essential Information:

Electro-Static Discharge (ESD) certification is required to handle the FTA hardware and supporting GSE at various points in the AIT and launch preparation process.

The GSE and FTA hardware are subject to established FTA Product Assurance and Safety Policies and Plans.

All FTA hardware and GSE operations will be scheduled with and coordinated through the FTA Project.

Participation in project reviews, teleconferences, Technical Interchange Meetings (TIMs), etc. is required as necessary.

Travel: Periodic trips to JSC, DFRC, WSTF, and WSMR are expected to conduct instrument and FTA Payload AIT activities. R1>The following travel dates have been identified.
September 10-14, 2007 PTR-3 Pre-Review, Denver, CO
September 24-28, 2007 PTR-3, Houston, TX
October 7-13, 2007, CDK, Aalborg, Denmark
January 2008, (1 week), Ground Ops Working Group, DFRC, CA
February 4-8, 2008, PA-1 CM to DFRC, DFRC, CA<R1

R2>It is anticipated that the Contractor will continue to provide computer resources necessary to perform the task order requirements. This access may include purchases of specialized software as coordinated with the Technical Monitor. <R2

5. Security Clearance:

Must have signed a nondisclosure agreement.

6. Period of Performance:

Planned start date: R1 January 25, 2007

Completion date:
R2 ~~April 30, 2008~~
R3 ~~September 30, 2008~~
R4 ~~December 31, 2008~~
R5 ~~March 31, 2009~~
June 30, 2009

7. NASA Task Management:

Technical Monitor (Required): R3 **Debbie Martinez**
M/S: 303 Phone: 864-6403
Other POC (Optional):
M/S: Phone:

TASK ORDER NUMBER: 002E5-NNL07AM54T Revision: 6 Change: 0 Date: March 5, 2009

Title: **Orion Crew Exploration Vehicle – Abort Flight Test Engineering Support**

1. Purpose, Objective, or Background (Optional) (This task continues the effort originating from SAMS Contract NAS1-00135 task order numbers 01D2B and 10RCG.)

This task order is in support of Crew Exploration Vehicle (CEV) Abort Flight Tests (AFT). LaRC is responsible to design, analyze, fabricate, and deliver Flight Test Articles (FTA's) and Ground Support Equipment (GSE) to support launch abort and ascent development flight tests. This task order is to provide contractor personnel to supplement the LaRC CEV-AFT engineering workforce. LaRC civil servants and contractors will work as an integrated team for this effort.

Revision 1 (2/23/07): Adds structural analysis requirements (new element 2.1.5) with updated schedule to Subtask 1, replaces the POC in Subtask 2, and updates the initial task order start date (see [R1] below).
Revision 2 (7/30/07): Updates/corrects/extends dates of and replaces the POC in Subtask 2 (see [R2] below).
Revision 3 (12/5/07): Extends the period of performance 9 months to September 30, 2008 in continuation of NASA's support, adjusts schedule accordingly, and clarifies safety and organization Subtask 2.n (see [R3] below).
Technical Direction 1 (12/13/07): Clarifies some dates and other ongoing details without affecting scope of requirements. Note some dates revert back to Revision 2 values (see [TD1] below).
Revision 4 (8/26/08): Extends the period of performance 3.5 months to January 15, 2009 in continuation of NASA's support, updates the schedule accordingly, and documents changes in Technical Monitor and POC's (see [R4] below).
Revision 5 (12/19/08): Extends the period of performance 2.5 months to March 31, 2009 in continuation of NASA's support and updates the schedule accordingly (see [R5] below). Note: This action will accommodate possible additional funding without having to do another task revision. However, there's no guarantee that additional funding will be available.
Revision 6 (3/5/09): Extends the period of performance 2 months to May 31, 2009 in continuation of NASA's support with updated Subtasks 1 and 3 Schedules, Subtask 3 Deliverables, and Subtask 2 POC data (see [R6] 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). Dates in braces {} are for information only and should not be planned in this Revision.*

2. Description of the Work to be Performed:

2.1. FTA GSE Development, Design and [R1]Analysis (Subtask 1):

2.1.1. The Contractor shall attend CEV-AFT GSE working group teleconferences in support of the FTA GSE planning, development and design. GSE includes handling, shipping, and lifting hardware; fabrication fixtures; and test support hardware.

2.1.1.1. The Contractor shall define requirements necessary for the development of the FTA GSE. The development of requirements will be an inter-center effort supported by government and contractor personnel.

2.1.1.2. The Contractor shall provide a comprehensive list of GSE that LaRC is responsible to build or purchase. The content of list will be developed by the CEV-AFT GSE working group. The Contractor shall book keep the list.

2.1.1.3. **Deliverables and Schedule:**

LaRC GSE list - Ongoing

2.1.1.4. **Metrics:**
Timely delivery of updates.

2.1.1.5. **Standards:**
Meets – Updated list next working day.
Exceeds – Updated list same working day.

2.1.2. The Contractor shall design CEV-AFT GSE.

2.1.2.1. The Contractor shall provide concepts for GSE. Concepts may be sketched or produced in CAD. Sketches should be created to support the working group activities and initiate designs.

2.1.2.2. The Contractor shall design GSE hardware. All designs shall be created in Pro/Engineer and Maintained in Pro/Intralink on the CAEDM-S2 server.

2.1.2.2.1. The Contractor shall generate detail drawing for GSE designs.

2.1.2.2.2. CAD modeling shall be done in accordance with the CEV-AFT Design Team Modeling Guide.

2.1.2.3. **Deliverables and Schedule:**
Drawings and sketches - Ongoing

2.1.2.4. **Metrics:**
Accuracy and completeness.

2.1.2.5. **Standards:**
Meets – No major errors or omissions.
Exceeds – No errors or omissions and submitted with 3 working days.

2.1.3. Interfaces and Communication

2.1.3.1. The Contractor shall interface with the FTA designers to define interfaces to the FTA hardware.

2.1.3.2. The Contractor shall interface with CEV-AFT operations personnel to define and capture functional requirements of GSE hardware.

2.1.3.3. The Contractor shall provide analysts with design information require to structurally analyze the GSE hardware. The Contractor shall consult with analyst to optimize the structural design of GSE hardware.

2.1.4. The Contractor shall support CEV-AFT Reviews

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

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

Begin R1 block addition

2.1.5. **The Contractor shall perform structural analyses in support of the GSE design and development:** These analyses will involve the structural modeling of the GSE hardware and analysis of these models using PATRAN/NASTRAN structural analysis tools. In addition, handbook calculations will be required, and will be preferred where applicable to speed analysis. Analyses will include, but not be limited to, stress (static and thermal), modal, and buckling. The Contractor shall perform these analyses in consultation with the relevant FTA designers and lead analyst, interpret results, and report these results to NASA technical points of contact. There are presently four primary components to the GSE: Fabrication tooling, Boilerplate (CM and Sep Ring) GSE, LAS pathfinder GSE, and test fixtures. 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.

Begin R3,TD1 block schedule adjustment

2.1.5.1. **Deliverables and Schedule:**

Fabrication tooling GSE models and final analysis — December 21, 2007

Boilerplate GSE: CM transportation models and final analysis — R4 ~~March 21, 2008~~ R5 ~~January 15, 2009~~ R6> ***PA-1 April 2009 {AA-1 – May 2010}***<R6

Boilerplate GSE: CM transportation lift kit models and final analysis — R4 ~~March 21, 2008~~ R5 ~~January 15, 2009~~ R6> ***PA-1 - April 2009 {AA-1 – May 2010}***<R6

Boilerplate GSE: Sep ring transportation models and final analysis — R4 ~~March 21, 2008~~ R5 ~~January 15, 2009~~ R6> ***PA-1 - April 2009 {AA-1 – May 2010}***<R6

Boilerplate GSE: Component lift fixtures conceptual models and preliminary analysis — January 18, 2008

Boilerplate GSE: Shipping crate conceptual models and preliminary analysis — April 13, 2007

LAS pathfinder GSE: fabrication and lift fixture conceptual models — February 13, 2008

Boilerplate GSE: Component lift fixtures model and final analysis — March 30, 2008

Boilerplate GSE: Shipping crate models and final analysis — September 30, 2008

LAS Pathfinder GSE: fabrication and lift fixture models and final analysis — February 29, 2008

Test fixtures: test definitions and concepts — February 29, 2008

Informal verbal or written summaries — Weekly at a minimum through R4 ~~September, 2008~~ R5 ~~January 15, 2009~~ R6> ***PA-1 - April 2009 {AA-1 – May 2010}***<R6

End R3,TD1 block schedule adjustment

2.1.5.2. **Metrics:**

Delivery and presentation of analysis results at team meetings.

2.1.5.3. **Standards:**

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

Exceeds – Regularly presents analysis status and findings at team meetings.
End [R1] block addition

2.2. FTA Structural Analysis (Subtask 2)

2.2.1. The Contractor shall perform structural analysis in support of the CEV FTA design and development. These analyses will involve the structural modeling of the FTA 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 FTA system designers. The Contractor shall provide structural design consultation with the primary FTA system designers. There are presently three primary components to the FTA, The CEV Capsule Simulator, the Launch Abort System Simulator, and an Interface Ring between the CEV capsule and other spacecraft components or test fixtures. 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:

2.2.2. **Identify, Capture, and Understand System Requirements Impacting the FTA Structural Analysis** – The Contractor shall identify and assemble a subset of FTA system requirements that will be used in the structural evaluation of the FTA. 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.

2.2.2.1. **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.

2.2.2.2. **Schedule:**
[R2]25 January 2007 through 16 February 2007

2.2.2.3. **Metrics:**
Delivery of requirements documentation.

2.2.2.4. **Standards:**
Meets – Documentation delivered by 23 February [R2]2007.
Exceeds – Documentation delivered on or before 16 February [R2]2007.

2.2.3. **Interface with FTA 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.

2.2.3.1. **Deliverables:**
Technical status, discussion and issues included in Monthly Status Reports.

Schedule:
R2 25 January 2007 through R3 ~~December 31, 2007~~
R4 ~~September 30, 2008~~
R5 ~~January 15, 200~~
March 31, 2009

2.2.3.2. **Metrics:**
Delivery of Monthly Reports and supporting data.

2.2.3.3. **Standards:**
Meets – Summary technical status included in monthly written reports.
Exceeds – Monthly face-to-face meeting with Structural and Thermal Systems Branch (STSB) Branch Head to discuss analysis status and progress.

2.2.4. **Perform Structural Analysis of Candidate Designs** - Using designer input, the Contractor shall develop suitable structural models and perform analyses per requirements identified in Subtask 1.0 TD1 and Subtask 3.0. 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.

2.2.4.1. **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.

2.2.4.2. **Schedule:**
R2 25 January 2007 through R3 ~~December 31, 2007~~
R4 ~~September 30, 2008~~
R5 ~~January 15, 2009~~
March 31, 2009

2.2.4.3. **Metrics:**
Delivery and presentation of analysis results at team meetings.

2.2.4.4. **Standards:**
Meets – Attends all team meetings or sends an analysis representative.
Exceeds – Regularly presents analysis status and findings at team meetings.

2.2.5. **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 TD1 and Subtask 3.0. The Monthly 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 Monthly 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.

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

2.2.5.2. **Schedule:**
Monthly Reports due by the third Friday of each month.
Final Report due R3R2 ~~December 31, 2007~~
R4 ~~September 30, 2008~~
R5 ~~January 15, 2009~~
March 31, 2009.

2.2.5.3. **Metrics:**
Delivery of status documentation.

2.2.5.4. **Standards:**
Meets – All documentation delivered by due dates.
Exceeds – Draft Final Report delivered on or before R3R2 ~~December 31, 2007~~ R4 ~~September 30, 2008~~ January 15, 2009.

2.3. Structural Definition of the FTA Crew Module TD1 and Separation Ring (Subtask 3)

The Contractor shall assist in the structural definition of the Flight Test Article (FTA) Crew Module (CM) TD1 and Separation Ring (SepRing) for Pad Abort 1 (PA-1), Ascent Abort 1 (AA-1), and other associated flight tests as required.

2.3 (a) The Contractor shall assist in developing, testing, and applying analysis methodologies for defining externally applied loads and internal structural loads for flight structure in support of the preliminary and final FTA CM TD1 and SepRing design phases and structural testing phase.
The Contractor shall perform and assist in performing analyses including, but not limited to:

- Creating and/or modifying and/or running structural Finite Element Models (FEM's)
- Coupled loads (CM + LAS TD1 and CM + LAS + SepRing) [LAS = Launch Abort system] dynamic analyses
- Transient response analyses
- Modal analyses
- Random vibration, static, and possibly acoustic analyses

The Contractor shall present results of analyses with periodic, informal verbal briefings and/or written summaries (weekly at a minimum), and written monthly status reports.

2.3 (b) The Contractor shall assist in defining structural layouts and structural sizing for the FTA CM in support of the preliminary and final design phases.
The Contractor shall perform tasks including, but not limited to:

- Creating global and local FEM's of primary and secondary FTA CM TD1 and SepRing structure for detailed hardware sizing
- Using FEM results where applicable for determining load paths and structural layout feasibility
- Using FEM results where applicable for sizing primary and secondary flight structure

- Performing hand calculations for sizing primary and secondary flight structure
- Documenting all sizing results in written summaries and reports

The Contractor shall present results of analyses with periodic, informal verbal briefings and/or written summaries (weekly at a minimum), and written monthly status reports.

2.3 (c) The Contractor shall assist in defining structural testing loads and testing setups in support of FTA CM TD1 and SepRing testing. The Contractor shall also assist in determining test predictions using FEM's and hand methods, and shall assist in reviewing test results and correlating FEM's to test data. The Contractor shall present results of analyses with periodic, informal verbal briefings and/or written summaries (weekly at a minimum), and written monthly status reports.

2.3.1 Milestones (Optional):

The first major milestone is to have external loads defined and internal structural loads developed for PA-1 for the FTA CM by January 31, 2007, including abort loads, ascent loads, and descent and landing loads.
The second major milestone is to have all critical load paths defined with associated structural layouts for PA-1 by February 9, 2007.
The third major milestone is to have primary structure and associated joints for PA-1 sized by February 15, 2007.
These dates are subject to change based on availability of externally supplied data.

2.3.2 Deliverables and Schedule (Required):

Element	Deliverable	Date
2.3 (a)	CM + LAS coupled loads for PA-1; R6>***CLA6 Loads Cycle***<R6	R6>***April 2009***
	CM descent (parachute) transient load analysis for PA-1	01-31-07
	Informal verbal or written summaries	Weekly (minimum), through R6>***May 2009***
	CM + LAS coupled loads for AA-1, other	R6>***{May 2010}***
	CM descent transient load analysis for AA-1, other	R6> ***{May 2010}***
2.3 (b)	Informal verbal/written summaries of structural layout and sizing requirements for PA-1 R6>***& stress reports***<R6	Weekly (minimum), through R6>***April 2009***
	Informal verbal/written summaries of structural layout and sizing requirements for AA-1, other	Weekly (minimum), through R6>***{May 2010}***
2.3 (c)	Define structural test loads and setups. Document test predictions.	R6>***{May 2010}***

	Review test data, and correlate FEM's	R6> *{May 2010}*

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

Meets: The task will be considered to meet MA if the assessment/analyses are comprehensive for the level of information provided by the government, and the deliverables are met.

Exceeds: The task will be considered to exceed MA if the assessment/analyses include comments and suggestions based on the insight and experience of the Contractor, including recommendations for alternative approaches and/or future activities to improve uncertainty quantification approaches and design methods incorporating uncertainty analysis.

2.n Working Environment Safety and Organization (Subtask 3)

The Contractor shall maintain working environment of accessed facilities and equipment as safe and organized to R3support 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: Travel will be Necessary for the support of CEV-AFT. The number of trips and the trip destinations are unknown at this time. CEV-AFT will provide trip information and funding as trips are scheduled.

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

6. Period of Performance:

Overall

Planned start date: January 25, 2007 Completion date: R3~~December 31, 2007~~
R4~~September 30, 2008~~
R5~~January 15, 2009~~
R6~~March 31, 2009~~
May 31, 2009

Subtask 1

Planned start date: R1January 25, 2007 Completion date: R1~~August 3, 2007~~
R3~~September 30, 2007~~

			R4TD1 ~~September 30, 2008~~ R5 ~~January 15, 2009~~ R6 ~~March 31, 2009~~ ***April 30, 2009***
Subtask 2 Planned start date:	R1 January 25, 2007	Completion date:	R2 ~~August 3, 2007~~ R3 ~~December 31, 2007~~ R4 ~~September 30, 2008~~ R5 ~~January 15, 2009~~ March 31, 2009
Subtask 3 Planned start date:	R1 January 25, 2007	Completion date:	R3 ~~December 31, 2007~~ R4 ~~September 30, 2008~~ R5 ~~January 15, 2009~~ R6 ~~March 31, 2009~~ ***May 31, 2009***

7. NASA Task Management:

R4> **Technical Monitor: Debbie Martinez**
M/S: 303 Phone: (757) 864-6403

Other POC (Optional): **William Berrios**
M/S: 432 Phone: 864-7183

Design POC (Subtask 1): John Dinonno
M/S: 303 Phone: (757) 864-2089 <R4

Structural Analysis POC (Subtask 2): **R6** ***David Moore***
M/S: 303 Phone: (757) 864-***9169***

R4> **Structural Definition of the FTA Crew Module POC (Subtask 3): Robert Parker**
M/S: 432 Phone: 757-864-7120 <R4

TASK ORDER NUMBER: 001B7-NNL07AM55T Revision: 2 Change: 0 Date: July 8, 2008

Title: Schedules Management and Reporting for OCIO

1. Purpose, Objective, or Background (Optional) (Reference SAMS Task Order Number: 01A3, OCIO portion)

The Office of the Chief Information Officer (OCIO) focuses on providing reliable cost-effective IT services that meet the Center's requirements. Further, OCIO is responsible for ensuring a secure IT environment that meets Agency and Federal guidelines. A variety of IT initiatives (aka, projects) are undertaken each year in support of this role.

Revision 1 (12/3/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and clarifies safety and organization Subtask 2.n (see [R1] below).

Revision 2 (7/8/08): Extends the period of performance 6 months to June 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 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) General Requirements

The Contractor shall coordinate with OCIO's Projects Integration Manager (PIM) to develop master and detail schedules to include major project milestones; maintain master and detail schedules; produce and deliver reports; and provide consultation and expert schedule advice. Although the requirements for deliverables may be modified from time to time for individual projects, the following is a generic list of planning and schedule management products required:

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

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

2.1.1 Deliverables:

- Planning and scheduling support shall be provided for weekly and monthly meetings and teleconferences; and planning team meetings shall be attended as necessary.

- Monthly –Project Plan schedules (Primavera Network) showing the level I, II and III milestones
- Monthly – Provide and review with Office PIM Monthly Management Report (MMR) that includes:
  - Actions from previous MMR review
  - OCIO Acronyms Listing
  - Program and all Projects (LV1 and LV2 milestones) color-coded roll-up chart
  - Program-To-Date Milestone Table
  - For each Project, color-coded roll-up chart with Program and Project (LV1 and LV2) milestones
  - For each Project, color-coded roll-up chart with Program, Project, and all Element (LV1, LV2 and LV3) milestones
  - For each Project, Primavera chart with Project and all Element (LV2 and LV3) milestones for 1 year period
  - For each Project, summary of Project and all Element (LV2 and LV3) milestones completed, delinquent, future slipping, and milestones due next month
- Monthly – Post entire Monthly Management Report to web-based management information system (NX) and notify Program personnel of its availability and url location
- Monthly – Update Excel Milestone Data Dictionary
- As Needed –Provide copy of full Data Dictionary to Program personnel
- As Needed – Provide appropriate sections of Data Dictionary to Project Managers
- As Needed – Review and analyze updated Project Plans for scheduling conflicts/issues
- As Needed – Coordinate with Project Managers to identify and document current FY tasks

2.1.2 Metrics:

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

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

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

Charts.

CUSTOMER SERVICE/RATING:

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

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

CUSTOMER SERVICE/RATING:

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

Standard 3: Produce and deliver accurate ad hoc reports in support of management reviews.

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

Standard 4: Provide consultation and expert schedule advice to projects. This consultation may be in the form of reports or schedule management recommendations.

CUSTOMER SERVICE/RATING:

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

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: N/A

4. Other Essential Information: OCIO will provide funds to cover travel costs.

5. Security Clearance:
Work under this Statement of Work is unclassified. Security clearances are not required.

6. Period of Performance:

Planned start date: [R1]25 Jan 07 Completion date: [R1]~~31 Dec 07~~
[R2]~~31 Dec 08~~
30 June 09

7. NASA Task Management:

Technical Monitor (Required): Virginia B. Marks
M/S: 148 Phone: 757-864-1714

Other POC (Optional): Frances DeMarco
M/S: 158 Phone: 757-864-2453

TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 01C2-NNL07AM56T Revision: 3 Change: 0 Date: December 2, 2008

Title: Flight Services and Meteorological Support

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01C2A)

The Langley Research Center (LaRC) supports flight research missions, as well as, program support, proficiency, and mission management. The Center hosts frequent visitors arriving via transient aircraft, including the regularly scheduled mission management service based at the Wallops Flight Facility. All these activities require support in the form of meteorological reports, general ramp and airfield procedures, NOTAM (Notice to Airmen) information dissemination, flight plan filing, and interaction with military and commercial flight operations.

Revision 1 (9/19/07): Extends the period of performance 12 months in continuation of NASA's support, adds potential support outside normal hours during severe weather, updates the initial task order start date to January 25, 2007, and re-designates safety and organization subtask as 2.n (see [R1] below).

Revision 2 (5/30/08): Extends the period of performance 6 months to June 30, 2009 in continuation of NASA's support and clarifies safety and organization Subtask 2.n (see [R2] below).

Revision 3 (12/2/08): Extends the period of performance 6 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 Contractor shall perform the following subtasks:

2.1 Meteorological Briefings, Alerts, and Updates:

- Integrate weather information from various sources to produce and deliver both routine and customized weather briefings based upon program or flight profile requirements. It is anticipated that approximately 10 pre-flight briefings per week will be required. These briefings shall be given to flight crews for research aircraft, support aircraft, and transient aircraft, and to flight teams on deployment.
- Maintain continuous watch on weather conditions during normal work hours and advise the safety office of any impending weather alerts, watches, and/or warnings.
- Using the public address system in the hangar, announce lightning proximity within ten miles of the Center and repeat announcements with distance updates until the hazard has cleared the area.
- Notify the LaRC Emergency Dispatch Officer 864-5500 inclement weather that may affect the city of Hampton or LaRC's area.
- Support the LaRC's Emergency Preparedness Officer or his representative during storms or other adverse weather situations that may affect the Center.

2.2 Langley Air Force Base Field Usage:

- Ensure authorization for transient aircraft on NASA business, at the rate of approximately 3 flights per month, but more during LaRC public events
- Serve as point-of-contact for information and documentation required for landing and assigning of landing permit (PPR).
- Be responsible for filing flight plans at the rate of 1-3 per day for research, support, and transient aircraft.

2.3 Radio Contact and Branch Notification:

- Maintain radio contact during research flights and provide current weather information during all flights at this Center.
- Provide notification of incoming aircraft to facilitate marshaling, parking/servicing, and dispatch.

2.4 LaRC Operations Point-of-Contact:

- Serve as the LaRC point-of-contact with Langley Air Force Base operations and other military and commercial airfield operations.
- Report results of monthly Air Traffic Control Board Meetings to the appropriate LARC personnel

2.5 Flight Office and Aircraft Dispatch:

- Provide flight office dispatch support, ramp observation, and security support, with particular emphasis on active taxiway encroachment and failures in traffic hazard warning system.
- Alert proper office of unauthorized encroachment of aircraft area or malfunction of taxi way warning or alert devices during normal duty hours.

2.6 Flight Hours Database Activity:

- Maintain and update current database of all flight hours generated by LaRC aircraft and pilots which includes landings, night currency, and flight hours by category and type.
- Submit flight hour data printouts to appropriate personnel each month as the official pilot currency record, historical file, and flight training requirement record.
- Implement any changes to the pilot currency system as might be required without loss of data.

Subtasks 2.1 through 2.6

Deliverables and Schedule (Required):

Monthly reports of activity

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

Minimum acceptable level of performance:

a. Provide forecasts for the Flight Operation Support Center at the rate of 90% per year.

b. Provide customized weather briefings for all research flights originating at LaRC at the rate of 90%.

c. Provides weekly pilot currency data with a 98% degree of accuracy.

Exceeds minimum acceptable level of performance:

a. Provides forecasts and weather briefings at a rate exceeding 90%.

b. Provides pilot currency data with a greater than 98% degree of accuracy.

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.

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 office space, work area space, office furniture, and utilities, and specialized equipment required for the performance of this task will be made accessible to the Contractor to include computers specially equipped with Government developed and/or procured software designed specifically for the accomplishment of this task.

4. Other Essential Information: This support is required during normal work hours (currently 0700-1530), but some support may be required during research flight missions R1>or to support the Emergency Preparedness Officer for potentially severe weather approaching the Hampton Roads area<R1 outside the normal shift.

5. Security Clearance: A secret clearance is required.

6. Period of Performance:

Planned start date:	R1 January 25, 2007	Completion date:	R1 ~~December 31, 2007~~ R2 ~~December 31, 2008~~ R3 ~~June 30, 2009~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): José A. Caraballo

M/S: 305 Phone: (757) 864-8994

Other POC (Optional):

M/S: Phone:

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TASK ORDER NUMBER: 001A4-NNL07AM57T Revision: 2 Change: 0 Date: November 5, 2008

Title: ETDPO Program and Project Planning and Control Support

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01A4)
The focus of this task is to provide program and project planning and control, including earned value analysis, support to the NASA Exploration Technology Development Program Office (ETDPO).

Revision 1 (10/9/07): Updates, clarifies, and adds various requirements, updates the initial task order start date to January 25, 2007, extends the period of performance 12 months to December 31, 2008, in continuation of NASA's support, and clarifies safety and organization Subtask 2.n (see [R1] below).
Technical Direction 1 (10/6/08): Adds an Alternate Technical Monitor (see [TD1] Section 7, below).
Revision 2 (11/5/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with various clarifications and updates (see [R2] below).

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

2.1 General Requirements

Unless otherwise specified, the Contractor shall coordinate with ETDP point of contact (POC) on the development of work breakdown structures at levels established by program management. The Contractor shall develop and maintain the Integrated Master Schedule (IMS) for ETDPO. The Contractor shall also [R1>]assist project in developing Integrated Project Schedules by coordinating, training, guiding, and directing detailed project schedules for the projects in ETDP.[<R1] Any discrepancies that arise between the overall master schedules shall be communicated to the appropriate program/project POC. The Contractor shall alert the POC should any discrepancies arise, involving major milestones and/or deliverables. The critical path and the resource critical path (if the schedule is resource constrained) shall be identified within the IMS as required by the ETDP POC. The Contractor shall assist the projects within ETDP in developing Monthly Status Reports (MSR) and assist in compiling these reports in to a program level MSR. The Contractor shall assist in preparing [R1>]Quarterly Program Management Reports (QPMRs)[<R1] for the program. The Contractor shall provide consulting and expert advice on schedules to the program or project management as requested [R2>]***or when deemed necessary to meet NASA requirements.***[<R2] The Contractor shall provide program or project with [R2>]***Earned Value Management (EVM)***[<R2] data and analysis and schedule risk assessment as required.

Deliverables and Schedule: The Contractor shall develop an integrated master schedule; maintain master and detail schedules; support projects in development of schedules; produce and deliver reports; and provide consultation and expert schedule advice to ETDPO. Although the requirements for deliverables may be modified from time to time, the following is a generic list of planning and schedule management products required: *Ongoing.*

- graphic reports Network Diagrams, Gantt charts, resource histograms
- management reports
- analytical reports and "white papers"
- management bullet/presentation charts
- WBS dictionary and/or hierarchical graphs
- Schedule Management Plan required to provide unique analysis or report formats (Primavera, Microsoft Project, etc.)
- [R2>]***development and documentation of processes; coordinating with configuration and data management guidelines***[<R2]

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

a) Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis requirements shall be documented in the Schedule Management Plan for each project.
b) Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports. For this reason, schedules shall be distributed electronically only in either Adobe or Microsoft PowerPoint formats.
c) Once a baseline has been established, changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database, which has not been baselined, shall be clearly identified. Changes to a baseline schedule [R2>] ***shall be implemented according to the process established by ETDP.*** [<R2] A record of approved baseline changes shall be maintained in a Change Control Log, [R2>] ***following configuration and data management guidelines.*** [<R2]
d) [R1] ~~For new schedule requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation. This assessment and planning activity shall be documented in the Schedule Management Plan.~~
e) The Contractor shall deliver all deliverables on time. The schedule of deliverables may vary by subtask.
f) Once a baseline master schedule has been approved, the Contractor shall maintain historical plan/actual data as part of the schedule database. The data shall include original duration/actual duration at completion and actual start/actual finish and baseline start and baseline finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects.
g) The schedule shall follow the guidelines established in NASA Procedural Requirement (NPR) [R1>]7120.8 "NASA Research and Technology Program and Project Management Requirement," [<R1] and the standards established by the Project Management Institute (PMI).

Standard 1: Support the development of Monthly Status Reports (MSR) for all projects and the program. Support the development of Quarterly Management Reports for the Program (QPMRs). The Program MSR/QPMRs follows the program Work Breakdown Structure, and includes, but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis, and Schedule Trend Charts.

CUSTOMER SERVICE/RATING:
Begin [R1] block acronym update

Excellent: The MSRs/QPMRs are delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate [R2>] ***program and/or*** [<R2] project management upon delivery of the MSRs/QPMRs to review the reports.
Very Good: The MSRs/QPMRs are delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MSRs/QPMRs with project management in a timely manner.
Satisfactory: The MSRs/QPMRs are delivered to the customer on the specified due date with minimum errors. Analyst reviews MSRs/QPMRs with project management.
Poor: The MSRs/QPMRs do not meet requirements of following the WBS. The MSRs/QPMRs are not delivered on the specified date and is not reviewed with the project management.
Unsatisfactory: No MSRs/QPMRs are delivered to the customer, and the customer has given no waiver.
End [R1] block acronym update

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

CUSTOMER SERVICE/RATING:

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

Standard 3: Produce and deliver accurate ad hoc reports in support of [R2>]*Center Management Council (CMC)*[<R2] and/or management reviews.

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

Standard 4: Provide consultation and expert schedule advice to projects identified in the task order as subtasks. This consultation may be in the form of reports (Trend Analysis, Schedule Risk Assessments, Critical Path or Resource Critical Path Analysis, Earned Value Analysis) or schedule management recommendations.

CUSTOMER SERVICE/RATING:

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

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.[<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:

4. Other Essential Information:

ETDPO will provide funds to cover travel costs. Expected travel would include trips to various centers approximately 4 times a year and trips to NASA Headquarters approximately 2 times a year. ETDPO will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract NNL07AA00B.

Begin R1 block addition

ETDPO requests that the Contractor remains current in the state of the art techniques and practices required for program and project planning and control, including earned value analysis. With this in mind, ETDPO supports periodic trade related seminar and conference attendance. ETDPO also supports training for the Contractor R2>***to complete the requirements for achieving Scheduling Professional certification with Project Management Institute (PMI).***<R2

End R1 block addition

5. Security Clearance:

As defined at the subtask level.

6. Period of Performance:

Planned start date: R1 January 25, 2007 Completion date: R1 ~~December 31, 2007~~ R2 ~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Richard C. Law, Jr
M/S: 178 Phone: 757-864-2184

Alternate Technical Monitor: TD1 **Pamela J. Stacy**
M/S: 109 Phone: 757-864-4918

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

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TASK ORDER NUMBER: 008D2-NNL07AM58T Revision: 4 Change: 0 Date: April 24, 2009

Title: Digital Signal Processing Software for On-board [R3>]Flight Operation[<R3]

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01D2A)

- This task order provides embedded digital signal processing to be interfaced as part of an On-board [R3]Flight System for the IVHM, [R3>]INFLAME and HyBoLT Projects[<R3]. Advanced future aircraft will have distributed systems with thousands of interconnected components: (1) Smart Sensors, (2) Processing Nodes, (3) Smart Actuators, and (4) Data Fusion Centers. The system incorporates NASA provided algorithms for Failure Detection and Isolation (FDI), self-healing signal conditioning and information fusion of communication channels. The measurement system will be required to operate and support laboratory flight simulation tests as dictated by the project schedule. This support entails ongoing development and improvement.

Revision 1 (5/31/07): Extends the period of performance and schedule seven months to July 31, 2008 in continuation of NASA's support requirements and updates the initial task order start date to January 25, 2007 (see [R1] below).
Revision 2 (6/28/07): Extends the period of performance and schedule two months to September 30, 2008 in continuation of NASA's support requirements (see [R1] below).
Revision 3 (3/25/08): Extends the period of performance and schedule one year to September 30, 2009 in continuation of NASA's support with some updated/clarified items including the title (see [R3] above and below).
Revision 4 (4/24/09): Extends the period of performance 3 months to December 31, 2009 with updated schedule to accommodate flight test date changes (see [R3] below).

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

The Contractor shall perform the following requirements:

1. Provide embedded digital signal processing support for an On-board [R3]Flight System for application to the IVHM projects. Provide data acquisition software that utilizes digital signal processing algorithms in a Field Programmable Gate Array (FPGA) for application to failure detection and isolation in aircraft information fusion centers. The Contractor shall modify and test new software in the required data acquisition system using government-supplied equipment. The Contractor shall develop software for a laboratory demonstration model of an FPGA-based acquisition board accommodating several different types of sensors (i.e. accelerometer, strain gage, thermistor, an array of acoustic sensors) providing inputs. Auto gain setting, auto spectrum analysis (for pre-sample filter selection), and self-healing shall be demonstrated. The data acquisition software for the small evolvable instrumentation system shall have the ability to process reconfiguration algorithms dynamically and autonomously in response to changes in task requirements or changes in the environment. This instrumentation shall be capable of measuring pressure, transition, model attitude and deformation, and temperature. The on-board system of instrumentation is made in a small form factor and has an electronic data handling capability accommodating a number of sensors. The software for the evolved system shall be capable of performing complex signal processing functions, such as adaptive filtering, randomization, and spectral analyses. The system shall accommodate a variety of serial protocols such as RS-422 and LVDS as required by the project. Data transmitted in blocks shall be stored in FIFOs (first-in-first-out memory) with simultaneous sampling occurring between channels. Interfaces between the FPGA and Digital Signal Processing (DSP) shall be developed.
    a. Implement simplified system calibration and setup techniques to enable personnel to configure, modify, download and run the software in a Field Programmable Gate Array as part of a laboratory test model. The system shall provide improved diagnostic information regarding the state of the system.

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

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

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

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

f. These files are to be distributed to customers via diskettes, CD-ROM, local network, internet, etc.

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

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

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

j. Phase II requirements consist of transferring the existing software design to a VHDL format and integrating this on a VII-Pro. The integration includes developing an application using Embedded Design Kit in an ultracontroller application that utilizes the PowerPC core with the FPGA device.

Begin R3 block clarification

2. Provide embedded processing support for an On-board Flight System for application to the INFLAME project:

The Contractor shall provide software for use in a real-time embedded single board computer to control data flow between multiple data acquisition boards and store the data to flash memory. The single board computer interfaces directly to an FPGA, an analog interface board, two engineering data system boards and a thermal control board for control and monitoring of optics in a Fourier Transform Spectrometer.

3. Provide data processing and analysis of flight data from the Data Acquisition and Processing System (DAPS) for the HyBoLT project:

The Contractor shall provide a graphical user interface (GUI) for processing and displaying the high frequency data obtained from the HyBOLT data acquisition system. The data shall be presented in pulse coded modulation (PCM) format. Algorithms for parsing the data, formatting, and displaying the various parameters shall be created. Matlab m-files will be provided to aid in the parsing of the PCM map.

a. The Contractor shall implement a Window's XP based GUI that displays system status, file options, and timing options such that: 1) the user is able to enter the day, hour, minute, and second time span in which to analyze the data of interest; 2) the user is able to choose which or all of the data in the specified time frame he/she wishes to have displayed. (Magnitude, Statistics, Time Series,…)

b. The GUI shall be configured to interface with the government provided Matlab m-files to perform the data parsing. The m-files shall also be modified to extract any data in the PCM map that functions have not already been written to do so.

c. The Matlab m-files shall be modified to write each section of data to a file in the Excel .csv format

d. The Contractor will also provide fully commented source code for both the GUI and any modified/added Matlab m-file functions.

e. The Matlab m-files shall be modified to enhance efficiency in speed and memory use.

f. The Contractor shall distribute these files to customers via diskettes, CD-ROM, local network, Internet, etc.

g. The Contractor shall provide technical support for a period of 30 days after completion of individual requirements to resolve any technical problems that may arise (not to exceed task order completion date).

End [R3] block clarification

Deliverables:

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

Schedule of Deliverables: [R3]IVHM - Ongoing through [R1]~~December 31, 2007~~ [R2]~~July31 2008~~ September 30, 2008
[R3>]INFLAME – Ongoing through [R4]~~April 30, 2009~~ ***June 30, 2009***.[<R3]
[R3>]HyBoLT – Sections 3 a-g July 31, 2008; Data Analysis through [R4]~~September 30, 2009~~ ***December 31, 2009.***[<R3]

Metrics for Performance:

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

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

- [R3>]Delivery of fully operational and tested embedded real-time processor that demonstrates control and operation of a Fourier Transform spectrometer using realtime LabView.[<R3]

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

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

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.[<R3]

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 tunnel and/or data acquisition facilities as required to perform the task order requirements.

4. Other Essential Information:

5. Security Clearance: None.

6. Period of Performance:

Planned start date:	[R1]January 25, 2007	Completion date:	[R1]~~December 31, 2007~~ [R2]~~July 31, 2008~~ [R3]~~September 30, 2008~~ [R4]~~September 30, 2009~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Sharon Graves

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

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 009D2-NNL07AM59T Revision: 3 Change: 0 Date: January 23, 2009

Title: Advanced Space Systems (Performance Analysis)

1. Purpose, Objective, or Background (Optional)

(NOTE: This task was 15RAA under SAMS contract.)

The NASA Langley Research Center [R2]Atmospheric Flight and Entry Systems Branch (AFESB) develops and applies computer-aided tools in the systems analysis of planetary exploration spacecraft. Engineering disciplines applied include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, operations, and mission risk analysis. Contract support is needed, primarily:

(a) to provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems,

(b) to perform analyses in selected disciplinary areas and,

(c) to provide computer software support for NASA flight projects supported by [R2]AFESB.

Products from these efforts include study results, analysis method and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computer systems.

Currently, the primary computational platforms are PC LINUX workstations. Apple Macintosh and PC WINDOWS also host a few engineering codes for systems analysis work. Specific requirements, deliverables with dates, metrics, and furnished materials are described below.

Revision 1 (8/24/07): Adds travel requirements, updates the initial task order start date to January 25, 2007, inserts safety and organization subtask as 2.n (included in previous Contractor's task plan but omitted from the PWS), and changes the completion date to March 31, 2008 (see [R1] below).

Technical Direction 1 (9/26/07): clarifies safety and organization Subtask 2.n (see [TD1] below).

Revision 2 (2/1/08): Adds requirements for state of the art advancement as new Subtask 2.6, extends the period of performance one year to 31 March 2009, and updates the branch's name throughout the PWS (see [R2] below).

Revision 3 (1/23/08): Extends the period of performance 12 months to March 31, 2010 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)

2.1 Maintenance of Performance Analysis Tools

The tools are designated into two groups. The first are those that support the general-purpose analysis, and those specifically designed to support the flight projects. The primary difference is that more computer software will be under strict revision control for the flight projects.

(a) The Contractor shall maintain and ensure proper performance of the POST family of trajectory analysis tools (POST3D, POST6D, POST2, and IPOST), support utilities (e.g., profil-matlab translator, monte carlo scripts), and other [R2]AFESB simulation tools referred to collectively as the "trajectory tools." The Contractor shall fix software bugs and problems resulting from modeling errors, programming techniques, or operating system changes. All software deliverables will be consistent with the current programming language for the affected subroutine and/or program, unless a waiver is granted. The Contractor shall produce sample case outputs and demonstrate that the enhanced code is consistent with previous results using the established test suite of input/output files. On average, five bug fixes per month and two operating system changes per year are expected.

(b) The Contractor shall provide programming support for trajectory performance/flyability studies including the development of general purpose and specific computer subroutine models of guidance and control, aerodynamics, atmosphere, and propulsion system models. Programming support tasks can be described as simple (model less than 500 lines of executable FORTRAN code), moderate (model between 500 and 5000 lines of executable FORTRAN code), or complex (model over 5000 lines of executable FORTRAN code). On average, 50 simple, 15 moderate, and three complex task per year are expected. The Contractor shall provide documentation of the software formulation, inputs/outputs, and test cases, and will produce a user's guide/document for the above mentioned subroutine models.

(c) The Contractor shall track these changes using ClearCase configuration management software.

(d) The Contractor shall provide static and dynamic software analyses of trajectory tools to determine sources of computational inefficiencies, recommend solutions, and implement modifications to improve efficiencies.

(e) The Contractor shall perform the above stated types of tasks for the NASA flight projects. The support of flight projects will require more stringent adherence to source control procedures, and may require that processes be developed to meet the R2 AFESB standards as will as the project standards.

2.1.2 Deliverables and Schedule (Required):

Specific deliverables and completion dates for the work breakdown elements are given below. See attached timeline schedule if appropriate.

ELEMENT	DELIVERABLE	DATE
2.1	Fully functioning programs which are free of known programming errors by the following schedule: within 1 week for a simple model, within 2 weeks for a moderate model, within 1 month for a complex model, and within 1 month for a new operating system/upgrade installation.	after the identification of a bug
	Documentation of the software formulation, inputs/outputs, test cases, user's guide, and instructions on the use of the new models in accordance with the following schedule: within 2 days for a simple model, within 2 weeks for a moderate model, and within 1 month for a complex model.	after the identification of a program modification

2.1.3 Performance Metrics/Standard:

The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

2.2 Trajectory Tool Transfer to R2AFESB Customers

The Contractor shall provide for the transfer of R2AFESB trajectory tools and documentation to customers upon request and will respond to customer inquiries concerning installation and operation of the tools on the customer's computer. The Contractor shall maintain a current list of customer contact points to whom tools have been transferred and shall provide a quarterly update to current users appraising them of the current version of the trajectory tools and any significant changes in these tools. The Contractor shall provide a monthly status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. Typically, three such requests are received every week. The Contractor shall assist in updating and maintaining the POST2 webpage (https://post2.larc.nasa.gov) which provides information about POST2and facilitates code transfer following all appropriate Langley procedures.

2.2.2 Deliverables and Schedule (Required):
Specific deliverables and completion dates for the work breakdown elements are given below. See attached timeline schedule if appropriate.

ELEMENT	DELIVERABLE	DATE
2.2	Status reports indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete.	monthly
	Software and documentation to customers.	as requested
	Updates to current users.	quarterly

2.2.3 Performance Metrics/Standard:

The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

2.3 POST2 Validation

(a) The Contractor shall validate that the test cases supplied by Lockheed-Martin execute properly using the contractor delivered POST2.

(b) The Contractor shall ensure that these test cases provide results consistent with the previous POST2 versions as appropriate.

(c) The Contractor shall develop additional test cases as needed to include all major models (aerodynamics, mass, atmosphere, etc.) and mission types (ascent, orbital transfer, entry, etc.) for the single and multiple vehicle option as well as include new test cases as available. The Contractor shall compare these cases using current and previous POST2 versions.

(d) The Contractor shall determine sources of computational inefficiencies, recommend solutions, and suggest modifications to implement that would improve efficiencies of the POST2 software. When suggestions and implementations are agreed to, effect their implementation into the POST2 code. The Contractor shall provide monthly status reports and document inputs/outputs and test cases used to validate the changes.

2.3.2 Deliverables and Schedule (Required):

Specific deliverables and completion dates for the work breakdown elements are given below. See attached timeline schedule if appropriate.

ELEMENT	DELIVERABLE	DATE
2.3	Documentation indicating that the test cases supplied by Lockheed Martin execute properly when new POST2 versions are provided.	within 3 weeks after code delivery
	Documentation indicating results from the comparison between current and previous POST2 test cases.	within 1.5 months after code delivery

2.3.3 Performance Metrics/Standard:

The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

2.4 Verification of Changes to Models in POST2

(a) The Contractor shall confirm the government changes to POST2 code when new capabilities, models, and variables are added to the POST2 software.

(b) The Contractor shall provide programming support to resolve any issues identified with the implementation of these changes.

(c) The Contractor shall demonstrate that the enhanced code is consistent with previous results using the established test suite of input/output files.

2.4.2 Deliverables and Schedule (Required):

Specific deliverables and completion dates for the work breakdown elements are given below. See attached timeline schedule if appropriate.

ELEMENT	DELIVERABLE	DATE
2.4	Installation on [R2]AFESB computers of fully functioning programs, free of known programming errors, which provide these capabilities, including source code, executables, and data files necessary to operate them.	2 months after delivery of government changes
	Evaluation of POST2 changes using test cases identified.	2 weeks after delivery of government changes

2.4.3 Performance Metrics/Standard:

The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

2.5 Source Control for Flight Project Support

The contractor shall maintain all [R2]AFESB-involved flight project related software under formal source control. This software includes the trajectory models, the Monte Carlo related software, inputs and outputs.

2.5.2 Deliverables and Schedule (Required):

Specific deliverables and completion dates for the work breakdown elements are given below. See attached timeline schedule if appropriate.

ELEMENT	DELIVERABLE	DATE
2.5	Incorporation of specified computer software and documentation into [R2]AFESB specified source control software.	within 2 days after code delivery
	Retrieval of any source control software or documentation, including the regeneration of previous executables.	within 1 day of request

2.5.3 Performance Metrics/Standard:

The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

Begin [R2] block addition
2.6 - State of the Art Advancement in Trajectory Analysis Software and Support Tools
The Contractor shall participate in appropriate technical conferences/short courses/meetings to maintain cognizance of new approaches in trajectory analysis software and support tools and to refresh skills, as needed, to *support the requirements of this task order*.

2.6.1 Deliverable: Debrief on the conference, short course, and/or meeting.

2.6.2 Required date: As identified in conjunction with the Technical Monitor.

2.6.3 Performance Metrics:

Exceeds: Innovative suggestions that combine/adapt new approaches/techniques.

Meets: Timely and thorough debriefing(s).

End [R2] block addition

Begin [R1] 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 [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.

End R1 block addition

3. Government Furnished Items:

- Access to R2AFESB Computer facilities (PC LINUX computers, LINUX Computer Clusters, personal computers (Apple and PC's)), the POST family of trajectory tools (POST2, POST3D, POST6D, IPOST, jplot, mat, mat2.24 table_plot), and other R2AFESB software (PBS, ABSOFT, MATLAB, etc.).

-Current suite of test cases for POST2.

- ClearCase source control software

4. Other Essential Information:

Reporting Requirements:

Monthly reports are requested for all work under this task including statements of progress, problems, and resources expended.

Begin R1 block addition

Travel:

Up to four (4) trips of up to four (4) days for one person may be required to support development and meetings as part of this task. Travel could be anywhere in the continental US, but Denver CO is most likely as the main POST2 contractor (LMA) is located there.

End R1 block addition

5. Security Clearance:

Secret clearance is required for tasks 2.1, 2.4, and 2.5 as the tools, modifications, and supporting software are being used with some projects that are classified as SECRET

6. Period of Performance:

Planned start date:	R125 January 2007	Completion date:	R1~~31 December 2007~~ R2~~31 March 2008~~ R3~~31 March 2009~~ ***31 March 2010***

7. NASA Task Management:

Technical Monitor (Required):		**Scott A. Striepe**
M/S: 489	Phone:	757-864-4512
Other POC (Optional):		
M/S:	Phone:	

TASK ORDER NUMBER: 039D3-NNL07AM60T Revision: 3 Change: 0 Date: March 10, 2008

Title: Computational Viscous Modeling Support for Supersonic Flow

1. Purpose, Objective, or Background (Optional)

Revision 1 (6/22/07): Extends the period of performance five months to March 31, 2008 in continuation of NASA's support requirements, documents a Technical Monitor added earlier (1/31/07), and updates the initial task order start date to January 25, 2007 (see R1 below).
Revision 2 (1/25/08): Requests a new estimate for full time support during the remainder of the work.
Revision 3 (9/27/07): Extends the period of performance 6 months to September 30, 2008 in continuation of NASA's support re-planned with updated strategy (see R3 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. See NOC designated item(s) and description below.

2.1 NOC (Requirement/subtask number one):

The Contractor shall perform the following requirements:

1. Generate 30 computational models (geom, surface grid, volume grid). Models include configurations with and without supports.
2. Generate 150 viscous solutions. Each of the 150 solutions shall include reqrd mods to the volume grids (defined in 1 above) as reqrd to accurately model critical flow structures.
3. Generate pre-solution graphics / images of computational models (min of 20/solution). Save solutions as high res pdf files and Tecplot format and the associated input files
4. Generate post solution images / graphics of surface and flow characteristics/features as defined by NASA. (min of 30/solution)

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

4/07 Generate and deliver 30 computational models

6/07 Generate and deliver pre-solution graphics / images of computational models (min of 20/solution)

7/07 Generate and deliver 150 viscous solutions.

8/07 Generate and deliver post solution images / graphics of surface and flow characteristics/features as defined by NASA. (min of 30/solution)

R3>***Note: The above types of deliverables will be due ongoing through September 30, 2008 in varying quantities as NASA's requirements are fully identified.***<R3

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

TASK ORDER NUMBER: 039D3-NNL07AM60T Revision: 3 Change: 0 Date: March 10, 2008

Title: Computational Viscous Modeling Support for Supersonic Flow

Meets: 90% of deliverables on schedule as specified in NOCs with no returns for omissions and errors.

Exceeds: Meets and significantly ahead of schedule in 60% of deliverables.

2.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:

4. Other Essential Information:

5. Security Clearance:

6. Period of Performance:

Planned start date: R1 January 25, 2007 Completion date: R1 ~~October 31, 2007~~ R3 ~~March 31, 2008~~ ***September 30, 2008***

7. NASA Task Management:

Technical Monitor (Required): **Richard M. Wood**
M/S: 499 Phone: 757 864-6174

Technical Monitor (Required): R1 **Linda S. Bangert**
M/S: 267 Phone: 757 864-3022

TASK ORDER NUMBER: 040D3 Revision: 1 Change: 0 Date: February 12, 2007

Title: Oculometer & Data Archiving Assistance

1. Purpose, Objective, or Background (Optional) (Completion to SAMS task order 04D3R)
The Integrated Intelligent Flight Deck Technologies project aims to develop technologies for improved operator state assessment in flightdecks. NASA has purchased an ASL 5000 dark pupil oculometer and LaserBird optical headtracker. The CANDAO experiment is an attempt to characterize how attentional sampling is affected by the use of a weather information system in a general aviation aircraft by instrument-rated private pilots. We require the assistance of a person who is highly experience with oculometers and the integration of oculometer data with head-tracking data, and in particular with ASL systems and software. This expert is required to contribute lessons learned from past experience and knowledge of relevant literature towards best practices in the verification and operation of an oculometer, and the analysis of oculometer, eye-head integration, and video data. This task also requires assistance structuring, archiving and accessing resulting experiment data. Expertise with the mass store system and ability to write datafile scripts for searching through and excising data from, directories and files is required.

Revision 1 (2/12/07): Adds requirements to subtask 2.1.3 for additional unforeseen processing of CANDAO flight test data files and updates metrics 2.3.3 and completion and deliverable dates accordingly (see [R1] below).
Technical Direction 1 (5/16/07): Updates the Period of Performance start and end dates to January 25, 2007, and June 30, 2007 to agree with initial issuance and with the no-cost extension granted on May 16, 2007, respectively (see [TP1] below, Section 6).

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

2.1 Subtasks

2.1.1 Contribution to "Best Practices" Document – The Contractor shall contribute lessons learned from prior experimentation, or experiences as are referenced in literature, to a paper on best practices in oculometer research for aviation applications, specifically with eye-head integration. The outline of this document and areas of contribution are as follows:

- Selecting an oculometer for aviation applications –dark/light pupil pupil/corneal detection, eye camera selection, scene camera selection,
- Ambient environment challenges & compensations -- lighting, vibration, magnetic interferences, headborne equipment, safety issues (egress, interference
- Oculometer installation & verification – challenges of installation (aircraft physical constraints), procedures for determining the accuracy and reliability of oculometer, head-tracker, and eye-head integration data, data analysis procedures for checking accuracy.
- Subjects for airborne oculometer research – physical characteristics, challenges with personal optics (glasses, contacts, sunglasses) for best subject selection; instructions to, and preparation of subjects for best data collection.
- Calibrating subjects – optimal characteristics of eye image for best calibration, procedures for assessing calibration accuracy, calibration data analysis procedures for assessing calibration accuracy.
- Data collection – procedures for ensuring that assumptions for accurate operation remain true during data collection (e.g., calibration, scene plane definitions, etc.), data analysis procedures for checking these assumptions, video data recording, event marking, data file structuring.
- Data analysis – best practices and caveats for deriving attentional focus, coverage (e.g., information access during saccades), and attention reorienting response times using oculometer data; identification of outliers and aberrations in data; statistical treatment of

fixation durations, transition matrices, and comparisons with different area-of-interest definitions, averaging data over subjects and flights ; and video data analysis procedures and software applications that support this.

Referenced proceedings, journal, or technical report literature shall be provided in hard or electronic copy to NASA TM

2.1.2 Coordination and Archiving Experimental Data: Data will be available from several sources including coded questionnaire data (excel files), preflight weather images and documents, flight parameter files, WSI InFlight weather information files, oculometer data and video files, flight digital video and digital audio recordings, GPS flight track files, and possibly WSI keystroke files. The Contractor shall perform the following requirements:

- Request data from FRSD staff, download data from each experimental flight from a hard drive and a handheld GPS
- Store data according to a naming convention and directory structure provided by the PI
- Check data for data anomalies to identify non-compliant and missing data, obvious anomalies, time-stamp inconsistencies, and system failure flags within the data that may hamper extraction of selected subsets of data and events by the defined scripts or other identified post-processing software. The Contractor shall provide a summary of problems discovered to the PI along with suggestions of salvage possibilities, if any, depending on the severity of the problems.
- Review recorded video tapes to an extent necessary to identify problematic losses of camera coverage that may effect subsequent utilization.
- Maintain a log file of data collected, and create scripts for selecting subsections of data, by time stamp or event key, from various files pertaining to a subject. These scripts shall be annotated and provided to NASA as source code, and as executables. It is imperative that the common time-synch of data is preserved. Corrections may be required if failures to achieve synching during the experiment are identified post-data collection. Archived data shall be contained both in a dedicated hard drive (provided by NASA) and on mass store. CDs (provided by NASA) shall be created for each subject as data when the complete data set for that subject is acquired. Assistance will be required to convert digital video tape to digital video files for approximately 6 hours total of video data, of approximately 30 minutes duration from 12 different tapes.

2.1.3 Experimental Data Processing and Analysis:
The Contractor shall perform the following requirements:
Begin [R1] block addition

- Develop methods to process oculometer flight test data files to extract statistics for yoke-mounted clipboard fixations excluded from some of the flight tests.
- Identify and properly label the time-stamp information for some files that were improperly time-stamped during data collection.

End [R1] block addition

- Provide RMS flight technical error (cross-track, vertical, track angle, flight path angle, speed, altitude) for subjects' flights, with intentional deviations identified separately and excised from the path-adherence calculation. Data for the lateral calculation should be available as crosstrack deviation from the CNX-80. Backup data is available from the handheld Garmin GPS track file or from the DAS system, but this would provide only position, not deviation directly. The CNX-80 doesn't provide deviation from intended altitude or speed. Target altitudes and speeds will be available from the flightplan, but deviations will need to be calculated.

- Based on path adherence assessment, identify the times at which, the extent of error, and the duration of excursion for lateral, vertical, and speed path adherence exceeds user-defined thresholds (default being flight technical performance: i.e.,
- Summarize oculometer data Using the ASL Eyenal and Fixplot software: Statistically characterize and provide fixplot images for dwell time and number of fixations in areas of interest (AOI) for each subject's flight, accumulated data over subjects for each condition and subject group, and accumulated data for each subject over conditions. Provide transition matrices for each subject per condition, as well as summarized over subjects for each condition and subject group, and conduct a link analysis of this data (% transitions among AOI).
- Characterize the reliability of oculometer data to include percent time pupil / CR was lost, duration, and where possible data to infer if loss was not spatially uniform.
- Develop coordinated data files and use these to plot pupil size and loss with light meter data and head movement, to identify characteristics of the external environment that affect oculometer data collection.
- Identify change detection performance: Acquiring times from WSI data for product renewal or recoding of data age labels, assess the timeliness of subjects' attention allocation to the MX20 FIS display.

2.2 Schedule of Deliverables

DELIVERABLE	DATE
2.2.1 Contribution to "Best Practices" Document	[R1] ~~April 30, 2007~~ May 31, 2007
2.2.2 Data coordination and archiving.	Episodically as data is collected.

2.3 Metrics

Timeliness and quality are the metrics. Timeliness is addressed in the schedule above, quality is addressed below. All reported items will be provided in MS Word documents.

2.3.1 Contribute to "Best Practices" Document–

Each section should contain bullet list of at least 3 recommended practices. The Contractor exceeds if substantial literature is referenced that contains unique contributions to 'best practices' using equipment that is comparable to state of the art in the relevant manner. The Contractor exceeds for recommendations regarding improvement in oculometer and/or analysis package design.

2.3.2 Data Coordination and Archiving

Metrics pertain to the correctness, completeness of the data archive, the speed with which experimental data, once provided, is included on the archive, and the functionality of inter- and intra-datafile search scripts. The Contractor exceeds if the entire data set for a subject is complete within 1

TASK ORDER NUMBER: 040D3 Revision: 1 Change: 0 Date: February 12, 2007

Title: Oculometer & Data Archiving Assistance

week of data provided. The Contractor exceeds if search scripts are implemented in Visual Basic or MATLAB.

2.3.3 Experimental Data Processing and Analysis – Metrics pertain to the speed with which experimental data, once provided, is analyzed, and to the degree that notes are provided to document difficulties in the analysis. The Contractor exceeds if the archive of the entire data set acquired for a subject is complete ahead of schedule. [R1]The Contractor exceeds performance criteria if at least 50% of problematic flight data is rendered usable for post-processing analyses.

2.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 Contractor will have access to the ASL DP-5000, associated equipment, and documentation. The Contractor will be provided with a PC-compatible hard drive for data storage to be returned to NASA. The Contractor will be provided with CDs for data recording as required.

4. Other Essential Information:

5. Security Clearance: *None*

6. Period of Performance:

Planned start date: [TP1]***January 25, 2007*** Completion date: [R1]~~April 30, 2007~~ [TP1]~~May 31, 2007~~ ***June 30, 2007***

7. NASA Task Management:

Technical Monitor (Required): Kara Latorella

M/S: 152 Phone: 757-864-2030

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 041D3-NNL07AM62T Revision: 3 Change: 0 Date: April 22, 2009

Title: Integrated Intelligent Flight Deck (IIFD) - Operator State Data Collection, Reduction, and Analysis Support

1. Purpose, Objective, or Background

The Integrated Intelligent Flight Deck project's R3> ***Operator Performance & Operator Characterization elements aim to conduct research towards technologies that will improved operator state determination and performance***<R3 assessment in flightdecks.

To support studies in this area, we require assistance in obtaining operator physiological, oculometric, and observational (video/audio) data; and in the behavioral coding, analysis, and archiving of this data.

Some experiments currently considered for this time period involve:

a) Assessment of new operator state sensing technologies and new methodologies for analyzing operator state data,

b) Validation of scenarios to induce specific operator states,

c) Evaluation of extent to which feedback permits pilot state modulation.

Revision 1 (8/21/07): Extends the period of performance 3 months to March 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007 (see R1 below).

Revision 2 (3/5/08): Extends the period of performance to 14 months to May 31, 2009 in continuation of NASA's support, updates/clarifies Subtask 2.1 requirements, adds other requirements as new Subtasks 2.2, 2.3, and 2.4, notes POCs for each subtask, summarizes deliverables, schedules, and standards/metrics in 2.5, and clarifies safety and organization Subtask 2.n (see R2 below).

Revision 3 (4/22/09): Extends the period of performance 19 months to December 31, 2010 in continuation of NASA's support with updated/clarified/added requirements and anticipated skills and workload among subtasks (see R3 above and 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)

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.

*****Begin R3 block update/clarification*****

It is envisioned that this work will require the skills of an experienced oculometer technician and the skills of a human factors expert who is capable of experiment design and familiar with oculometers. The expert oculometer technician's time would be distributed among tasks 2.1, 2.2, 2.3, and 2.7. The human factors expert' time would be distributed between tasks 2.6 and 2.7. Sub-task 2.7 is also intended to serve as a training opportunity. The intention is to invest in this training to minimize risk to future oculometric studies, by having additional personnel trained as competent oculometer technicians.

2.1 In Support of: OCAPI Lab. (POC: Kara Latorella)

Required support is incidental and will be negotiated as needed, and through NOC if contractors request this.

Objective:

This effort aims to support research for the IIFD/OP&OC program elements and, in part to do so, to develop capabilities from and within the OCAPI Lab. For this effort, the Contractor shall provide support required to assist in equipment installation, checkout, conduct of experiments, and data analysis resulting from IIFD/OP&OC experiments. Activities that would support this requirement and may be necessary on a surge basis may include, for example:

****End R3 block update/clarification*****

a) Develop the capability of recording and analysis of physiological data using, R2>*for example*,<R2 the gTEC mobilab system for use in NASA workstation, simulation or aircraft facilities.

b) Develop and implement methods to assess and improve eye-tracking system data integrity during functional tests and data collection runs.

c) Provide audio/video-recording capability, using NASA supplied video recording hardware, for playback of test runs, to include behavioral coding, timestamp, and point of gaze if oculometric data is taken.

d) Develop a practitioner's protocol for using the gTEC mobilab instrumentation.

e) Develop and implement scenarios (flight path parameters) in accordance with research team and experiment goals.

f) Develop and implement data/video gathering plans, and post-experiment data and video analyses of experiments and demonstrations using workstations, simulators, or flight facilities.

g) Maintain a data archive center with indexing and search scripts for experiment data files and audio/video sources.

h) Evaluate and analyze experimental data from simulation and flight experiments using government furnished analysis packages such as SPSS or other appropriate data analysis and/or visualization tools.

i) Develop and implement algorithms for data fusion of sensor inputs for operator state identification, and for post hoc analysis of data.

j) Develop and/or implement post-run subjective measurement techniques (via paper or portable electronic devices) as appropriate for the research questions under test.

k) Provide pertinent data to permit documentation of study results.

l) Develop and field surveys using pre-existing tools R3>***(e.g., SurveyMonkey.com)***<R3, collate and analyze results deriving from these surveys.

m) Provide equipment management services as R3>***identified by TM***<R3.

****Begin R3 block update/clarification*****

2.2 (Previous 2.1.1) In Support of "Oculometer Best Practices" Document (POC: Kara Latorella)

As of Revision 3, this task will require the contractor to provide a final review of the compiled document and to clarify information previously delivered.

2.3 (Previous 2.1.2) In Support of CANDAO Experiment Data Processing Analysis (POC: Kara Latorella)

As of Revision 3, this task requires archive management of data and analysis files, consultation with TM for analysis and bi-weekly meetings for review of analyses and interpretation of results. In addition, this may require re-running FSQ files with new AOI definitions and/or offsets – not to exceed three separate attempts for all data runs. Support will require a review of paper(s) that document this work.

2.4 (Previous 2.2) In Support of: "Operator Characterization & Assessment Review" (POC: Catherine Adams)

As of Revision 3, this subtask is on hold. No further work is required at this time.

2.5 (Previous 2.3) In Support of: Operator State Decision Aid for Detecting and Preliminary Diagnosis of User State (POC: Anna Trujillo)

As of Revision 3, this subtask is on hold. No further work is required at this time.

2.6 (Previously 2.4) In Support of: Interaction of Pilot with Adaptive Controller (POC: Anna Trujillo)

***Objective*:**

Adaptive control in flight applications has a long and rich history dating back to the 1950s. Currently, adaptive control is needed for highly uncertain, and potentially unpredictable, flight dynamics characteristic of upset recovery or damage induced on transport as well as high-performance aircraft. Some of the recent flight experiences of pilot-in-the-loop with an adaptive controller have exhibited unpredicted interactions. In retrospect, this is not surprising once it is realized that there are now two adaptive controllers interacting, the traditional software adaptive control system and the pilot. The pilot is another entity that may affect the attitude of the vehicle (definition of a control system) and the pilot's method of controlling may change due to slowly varying or uncertain system parameters. A hypothesis for problems with adaptive controller interactions is that the pilot does not realize what the adaptive controller is doing and what the limits of the adaptive controller are, and therefore interactions are inappropriate. This line of research investigates adaptive controller and operator variables that interact with one another through human-in-the-loop simulation. Once the meaningful variables are discerned, the operator interactions with an adaptive controller can be characterized. This will allow a decision aid that defines adaptive controller performance by maneuver characteristics to be designed. Lastly, possible function allocation schemes between operator and adaptive controller can then be defined. The tasks detailed below will be in support of an experiment to define operator interactions with an adaptive controller.

The Contractor shall perform the following requirements:

(1) Help design subject questionnaires that fulfill Experiment Requirements.
(2) Provide input to maintain Experiment Requirements document.
(3) Help run experiment. This may entail running a subject by oneself or running a subject with another experimenter; therefore, must have current IRB's Human Research certification.
(4) Help analyze post-test questionnaire and subject comment data.
(5) Provide documentation on methods used for analysis.
(6) Provide review of report.
(7) Provide monthly progress reports by the 4th of each month.

*****End ^{R3} block update/clarification*****

*****Begin ^{R3} block addition*****

2.7 In Support of: Pilot State Estimation using a Haptic Stick (POC: Ken Goodrich)

Objective:

NASA LaRC uses an active haptic sidestick in their research on H-mode control. This H-mode control is based on the horse metaphor, which describes the principle of allowing the human operator to control a system at various levels of interaction and with constant haptic feedback on the system's actions. This support system acts on an outer loop of the system's controls; there may be an additional inner loop for stability or control augmentation. In accordance with the horse metaphor, it is desired to investigate the possibility of more subtlety inferring the pilot state from his interaction with the haptic sidestick, with the goal of feeding this information to the H-mode system for adjustments to the level of haptic support. This can be compared with a horse sensing the tension through the reins and adjusting its tendency to act autonomously even before any explicit control input is given by the pilot (assuming that tightening or loosening the reins is in itself not considered a control action). This experiment will generate a data set of human-automation interaction with varying degrees of pilot workload, haptic support, divergence between the path desired by the pilot and the automation, and external disturbances. The data set will be used off-line to identify potential signals useful in inferring pilot state, task engagement, and desire to change haptic support level.

To be able to fulfill the requirements set forth, a "switching yard" experiment was devised. The pilot will be requested to follow an indicated track and switch tracks at given times. The haptic guidance will automatically switch to the newly requested track at a latter time, creating a period of conflict between the human and automation. The entire path the pilot is asked to fly will be presented (thus including the transition between tracks) and the pilots are asked to reduce the deviations from that requested path. A secondary task will be included to manipulate workload.

Oculometer (i.e., pupil size) and physiological data will be collected presumed to be correlates of task workload. This will require implementation of the ASL 5000 oculometer and assistance in using the gTEC mobilab physiological data collection device. This experiment is scheduled to run in May 2009, with a possible extension running until end of July 2009. This task will serve as a training opportunity to ensure that there are at least two WYE staff available to serve as competent oculometer technicians.

The Contractor shall perform the following requirements:

(1) Set up and operation of oculometric data (pupil size and gaze tracking) collection equipment.
(2) Operation of the gTEC equipment if necessary, after instruction by civil servant staff.
(3) Assistance in running subjects and data archiving.
(4) Oculometric data reduction for pupil size assessment with reference to experimental conditions
(5) Provide monthly progress reports by the 4th of each month.
This report will be included in the NASA LaRC OP&OC Task Monthly Report.

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

2.8 (Previous 2.5) <u>Deliverables, Schedule, and Standards/Metrics</u>:

2.8.1. (NOC) All specifications-development, planning and pre-execution contributions, and data analyses for the planning and execution of experiments and demonstrations shall be performed in accordance with NOCs provided by NASA. Each NOC will specify objectives, expected accomplishments, and delivery dates to complete the requirements. It is anticipated that three to five NOCs of two to five months duration each will be generated during the performance period. Deliverables specified by NOC shall include informal verbal and written reports for experiment and demonstration planning purposes, specifications for data collection and analyses, contributions to plan-of-test documents in support of experiments, post-experiment data reduction and analyses, and post-experiment video editing/ analyses.

2.8.2. The Contractor shall support proposed studies to be specified by NASA. This support may include assessing plan-of-test documents for particular research designs and test conditions, scenario development, and plans for analysis. The Contractor shall be responsible for properly installed, tested, and operational NASA furnished data acquisition equipment, including eye-tracker systems, physiological systems, post-run survey instruments, and audio/visual data collection instrumentation. This requirement is anticipated for one occurrence during the performance period. Specifications for hardware and software upgrades shall also be provided by the Contractor based on specifications for the studies. Minor system reconfigurations shall be accomplished within two months and major upgrades within six months of Contractor receipt of government supplied specifications and components.

2.8.3 Deliverable Schedule:

****Begin R3 block update/clarification****

Specific dates are subject to negotiation between the researcher and contractor as requirements develop. NOCs may be submitted to modify support required for other aspects of any subtask.

Subtask 2.1

(1) Occasional technical assistance (on the order of 2 hours per week) to assist with Smart Eye implementation and testing.

Subtask 2.2

(1) Two document reviews. The dates shall be coordinated with TM/POC, but nominally end of July and August.

Subtask 2.3

(1) Data and data processing archive maintenance task (ongoing).
(2) Bi-weekly meetings for review of analyses and interpretation of results.
(3) Potentially 1 revision to each of Lookpoint and Flight Segment AOIs.
(4) Potentially running new sets (for 8 legs) of fixation files and fsq files. Need for this is TBD, but maximum number of re-runs would be 3. Deadline for each request would be 10 working days from request.
(5) Provide written input for final report that describes oculometric data treatment. (June 16, 2009).
(6) Provide review of final report. (10 days after draft report delivered).

Subtask 2.4 (none)

Subtask 2.5 (none)

Subtask 2.6

(1) Help design subject questionnaires that fulfill Experiment Requirements.(June 30, 2009)
(2) Provide input to maintain Experiment Requirements document. (June 30, 2009)
(3) Help run experiment. This may entail running a subject by oneself or running a subject with another

experimenter; therefore, must have current IRB's Human Research certification. (October 31, 2009)
(4) Help analyze post-test questionnaire and subject comment data. (December 31, 2009)
(5) Provide documentation on methods used for analysis. (December 31, 2009)
(6) Provide review of report. (March 31, 2010)
(7) Provide monthly progress reports by the 4th of each month. This report will be included into the OP&OC Task Monthly Report. 4th of each month until April 4, 2010

Subtask 2.7

(1) Ensure all participants have current IRB Human Research certification through August 1, 2009 or obtain this certification by May 1, 2009.
(2) Prepare data collection equipment for experiment checkout (oculometer and gTEC) (May 1, 2009)
(3) Coordinate with POC to staff data collection opportunities.
(4) Provide raw eyd files and fixation files with pupil size data and data run annotations (e.g., of off-nominals that affect data) within 2 working days of each subject completed.
(5) Provide ASL Pupil Summary data within 7 days after the subject completed.
(6) Maintain an archive copy and database of oculometric and physiological data collected.
(7) Review resulting interpretations of these data.
(8) Conduct training for second WYE as oculometer technician.

*****End R3 block update/clarification*****

2.8.4 Standards/Metrics

Meets: Timely delivery of the required items with adequate and reasonable detail and clarity to accomplish specified objectives. Documentation of the data reduction and analyses should provide adequate detail to support formal NASA reporting.

Exceeds: Early completion of specified deliverables, quality/quantity of deliverables in excess of requirements, or contributions that result in added value of experiment or demonstration results.

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.

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: Equipment: The Government shall supply as necessary, data acquisition computers, eye-tracking system and related peripheral devices (e.g. head tracker, cameras and camera control units, ancillary monitors, mounts in simulation environment for peripheral devices), gTEC mobilab, wireless monitoring cameras, desktop computers to host the software packages necessary to complete the required tasks including a host computer for website(s). Acquisition of hardware and software upgrades will be furnished by the government based on specifications recommended by the contractor.

TASK ORDER NUMBER: 041D3-NNL07AM62T Revision: 3 Change: 0 Date: April 22, 2009

Title: Integrated Intelligent Flight Deck (IIFD) - Operator State Data Collection, Reduction, and Analysis Support

Descriptions of the experiment design for each planned test: The Government will be responsible for providing specifications for operator state sensing and classification methodologies, experimental plans, and scenarios to be developed. The Government will also furnish necessary commercial software for required software development, data analysis, database management, flowcharting, etc. as well as a video editing and data archive facility.

4. **Other Essential Information**: Software shall be developed in compliance with the LaRC software procedures.

5. **Security Clearance:** None of the tasks to be performed will require handling of classified material or documents. However, non-disclosure agreements may be required with industry partners due to the proprietary nature of their contributions. R3> ~~ADP clearance for lab area (B1268/R2 R2131B)~~ <R3

6. Period of Performance:

Planned start date:	R1 January 25, 2007	Completion date:	R1 ~~*December 31, 2007,*~~ R2 ~~March 31, 2008~~ R3 ~~May 31, 2009~~ ***December 31, 2010***

7. NASA Task Management:

Technical Monitor (Required):

Kara Latorella M/S: 152 Phone: 757-864-2030

Other POC (Optional):

Anna Trujillo M/S 152 Phone: 757-864-8047

R3> ***Ken Goodrich M/S 308 Phone: 757-864-4009*** <R3

TASK ORDER NUMBER: 043D3-NNL07AM64T Revision: 3 Change: 0 Date: September 26, 2007

Title: Antenna Structural Design, Testing, and Analysis

1. Purpose, Objective, or Background (Optional)

This task order is a continuation of work performed under the old SAMS contract number NAS1-00135 task order 16RFF [R1]and task order 10RCG. The title and overall objectives have been modified and revised for the TEAMS task order. The purpose of the task is to provide structural design, testing, and analysis support for the development of antenna technologies and evaluation of antenna test article hardware being developed for high speed (Ka-Band) data relay communications in-space. Specific technical challenges to be addressed include determining deployed shape accuracy and repeatability, thermal distortion and control, evaluating materials for packaging and repeated deployment, and structural validation methodologies. [R1]Also the purpose of the task is to characterize the static and dynamic distortion of antenna structures and to analytically develop dynamically scaled models of such structures that are under evaluation for laboratory testing. These challenges will be investigated through studies on various test platforms to be provided to NASA-Langley from hardware developers.

Revision 1 (3/27/07): Adds requirements previously issued under task order 042D2 (NNL07AB63T) as new subtasks 2.1-2.3, renumbers old subtasks accordingly as 2.4-2.8, and updates the start date to January 24, 2007 (see [R1] above and below).
Revision 2 (6/18/07): Extends the period of performance nine months to September 30, 2008 and refocuses task on analytical activities to align with FY08 program priorities/funding. (see [R2] below).
Technical Direction 1 (9/25/07):clarifies safety and organization Subtask 2.n (see [TD1] below).
Revision 3 (9/26/07): Extends the period of performance 9 months to June 30, 2009 to accommodate changing NASA program priorities within funding constraints (see [R3] below, Sections 4 and 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. See NOC designated item(s) and description below.

Begin [R1] block addition

2.1 Development of Dynamically Scaled Antenna Structural Models

The Contractor shall evaluate, through analysis, methodologies to develop dynamically scaled antenna structural models to aid in evaluation of full scale antenna performance under in-space conditions.

− The Contractor shall develop structural analytical models of antenna test articles

− The Contractor shall evaluate and compare analytical simulations with test results to predict model capabilities for predicting antenna performance

− The Contractor shall develop ways to dynamically scale the antenna concepts

2.1.1 Deliverables and Schedule:

- Figures and plots archiving the analysis results - noted in NOCs
- All models and analysis data shall be stored and archived - noted in NOCs
- Written memo on data analysis conclusions and lessons learned - noted in NOCs

2.1.2 Performance Metrics/Standard (Meets, Exceeds):

- The analysis data shall be useful for drawing conclusions regarding antenna performance

2.2 Development of Full-Scale Antenna Structural Models

The Contractor shall develop full-scale antenna structural models to evaluate performance under in-space conditions for operational antenna concept. The intent is to update analytical models and perform simulations of antenna performance for various mission scenarios with different thermal profiles.

– The Contractor shall develop full-scaled versions of antenna test articles

– The Contractor shall verify design parameters and structural performance of full-scale models and determine suitability of model for use in predicting on-orbit antenna performance

2.2.1 Deliverables and Schedule:

- Figures and plots archiving the analysis results - noted in NOCs
- All models and analysis data shall be stored and archived - noted in NOCs
- Written memo on data analysis conclusions and lessons learned - noted in NOCs

2.2.2 Performance Metrics/Standard (Meets, Exceeds):

- The analysis data shall be useful for drawing conclusions regarding antenna performance

2.3 Contribute toward Development of Structural Test Planning

The Contractor shall participate in structural test planning to ensure feasibility and availability of sufficient and suitable data for analytical model validation.

– The Contractor shall participate in identifying and developing test plans that are important to aid in structural model validation

– The Contractor shall participate in ongoing test activity to better understand assumptions and how they may impact model validation against test data

2.3.1 Deliverables and Schedule:

- Participation in test planning meetings and ongoing discussions with hardware developers

2.3.2 Performance Metrics/Standard (Meets, Exceeds):

- The analysis simulations should properly incorporate the test configuration under study
- Assumptions in modeling and test conditions that may impact the capability to validate models are to be documented and described and recommendations for improvements identified

End [R1] block addition

Begin [R2] block edit

2.4 Deployed Shape and Surface Accuracy

The Contractor shall support shape and surface accuracy tests of antenna test articles for repeated deployments and under various loading conditions (i.e. pressure, thermal, etc.). Commercially available analytical methods that predict RF performance based on structural shape shall be investigated and used to develop approaches to defining antenna manufactured shape to optimize on-orbit RF performance.

– The Contractor shall support the identification of instrumentation required for testing to support analytical model validation

– The Contractor shall analyze reduced test data and draw conclusions regarding antenna performance as compared to analytical predictions

– The Contractor shall report status of work through monthly reports

2.4.1 Deliverables and Schedule:

- Plots and drawings archiving the test instrumentation locations - noted in NOCs
- Written memo on analysis conclusions and lessons learned - noted in NOCs

2.4.2 Performance Metrics/Standard (Meets, Exceeds):

- The instrumentation locations shall produce test data useful for drawing conclusions regarding antenna performance

2.5 Development of Rigidizable Antenna Models

The Contractor shall develop structural models for inflatable, rigidizable antenna test articles and support structural tests (i.e. dynamics, etc.) in ambient and vacuum conditions. Analysis approaches for various configurations of the antenna (rigid with no inflation, rigid and inflated, etc.) will be required. The testing intent is to produce data to update analytical models and perform simulations of antenna performance for various mission scenarios with different thermal profiles.

– The Contractor shall develop structural analytical models of the test articles in various configurations that simulate test conditions

– The Contractor shall provide information to support the development of the test fixtures and instrumentation locations for the antenna test article

– The Contractor shall analyze reduced test data and perform test-analysis correlation, including model updates

– The Contractor shall report status of work through monthly reports

2.5.1 Deliverables and Schedule:

- Plots and drawings archiving the test instrumentation locations - noted in NOCs
- All analysis models, test-analysis correlation studies, and final results stored and archived - noted in NOCs
- Written memo on analysis conclusions and lessons learned - noted in NOCs

2.5.2 Performance Metrics/Standard (Meets, Exceeds):

- The instrumentation locations shall produce test data useful for drawing conclusions regarding antenna performance
- The analysis models shall be developed to match the test conditions under evaluation and produce meaningful results to aid in assessing antenna performance

2.6 Publication of Lessons Learned at 2007 AIAA-SDM Conference

The Contractor shall document test and analysis work completed in FY06 and early FY07 in the AIAA-SDM conference paper for 2007 and present the results at the conference.

2.6.1 Deliverables and Schedule:

- Conference paper and presentation by Contractor at 2007 AIAA-SDM Conference

2.6.2 Performance Metrics/Standard (Meets, Exceeds):
- The conference paper shall describe test and analysis completed and important lessons learned
End R2 block edit

2.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:
Government Furnished Property and software will be furnished for the design, fabrication, R1analysis and testing of the deliverable items.

4. Other Essential Information:
4.1 One or two trips to a vendor facility. Trip is necessary to confer with the manufactures of the antenna test articles.
4.2 Some off-site test support required.
R3***Note: An anticipated ramp down through CY08 with return to CY07 activity levels in first half of CY09 should be considered for planning purposes.***

5. Security Clearance: None

6. Period of Performance:

Planned start date: R1January 25, 2007 Completion date: R2~~December 31, 2007~~
R3~~September 30, 2008~~
June 30, 2009

7. NASA Task Management:

Technical Monitor (Required): James L. Gaspar
M/S: 230 Phone: 757-864-4326
Other POC (Optional): Jill M. Marlowe
M/S: 230 Phone: 757-864-7027

TEAMS Task Order Performance Work Statement (PWS)	Page 1 of 6
TASK ORDER NUMBER: 044D3-NNL07AM65T Revision: 2 Change: 0 Date: June 6, 2008	
Title: Measurement Science Support	

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 35RBG)
This task order supports the development and application of state-of-the-art instrumentation technologies. The purpose of this task is to provide custom design, fabrication, assembly, integration, and documentation support in the following areas:

- Micro/Nano sensing techniques
- Doppler Global Velocimetry
- Point Doppler Velocimetry
- Pressure Sensitive Paint development
- Particle Image Velocimetry,
- Molecular Diagnostics
- Projection Moiré Interferometry
- Video Model Deformation and other Videogrammetric Measurements
- Multi-point Laser Vibrometry
- Unified testing in the laboratory and in NASA facilities.

Revision 1 (8/17/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, adds requirements as new Subtask 2.6, and updates the initial task order start date to January 25, 2007, and clarifies safety and organization Subtask 2.n (see R1 below).
Revision 2 (6/6/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see R2 below).

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

The Contractor shall perform the following subtasks:

2.1 Molecular Optical Measurement Techniques: Assist researchers in developing optimal design and then fabricate components required for the development of Molecular Optical Measurement techniques, to include:

(a) Components for molecular optical measurement lab and other Langley facilities;
(b) Components required to modify generic hypersonic model to test "Molecular Tufts" technique in the 15 inch Mach 6 High Temperature Tunnel (contingent on C of F completion and tunnel availability);

Deliverables and Schedule: The Contractor shall provide:

1. Custom optical mounts required for tunnel test;
2. Miscellaneous hardware in support of Laser Induced Thermal Acoustic(LITA) and other molecular diagnostic development;
3. Metal inserts to install seeding system in hypersonic model;
4. Mechanical drawings of all constructed components in DXF format;
5. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Ongoing through task order completion.

Performance Metrics/Standards
Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 2.1 will be based on the following:

- Fabricated components shall meet all specifications provided by drawings supplied by NASA

within the contracted cost.
- Deliverables shall all be received for timely implementation to meet LaRC mission objectives
.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 2.1.
- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than required for implementation to meet LaRC mission objectives.

2.2 Optical Diagnostics and Chemistry R&D: Design and fabricate components for advanced optical diagnostics and advanced chemistry research and development, to include:
(a) Design and fabricate various hardware components in support of the advanced optical diagnostics.
(b) Design and fabrication of advanced sensor systems that are under investigation by the advanced chemistry group.

Deliverables and Schedule: The Contractor shall provide:
1. Miscellaneous hardware components for Point Doppler Velocimetry, Multi-point laser vibrometry, Projection Moire Interferometry, Video Model Deformation, General Videogrammetry, IR diagnostics, Doppler Global Velocimetry, Particle Image Velocimetry, and other advanced sensing techniques.
2. Mechanical drawings of all constructed components in DXF format;
3. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Ongoing through task order completion

Performance Metrics/Standards
Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 2.2 will be based on the following:
- Fabricated components shall meet all specifications provided by drawings supplied by NASA within the contracted cost.
- Deliverables shall all be received for timely implementation to meet LaRC mission objectives

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 2.2.
- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than required for implementation to meet LaRC mission objectives

2.3 Shear Stress Sensor Research and Testing System: Design and fabricate components for shear stress sensor research and testing system, to include:
(a) Design and fabricate fixtures for test and evaluation of direct shear stress measurement techniques.
(b) Integrate MEMS indirect shear sensors into test articles for Advanced Sensing and Optical Measurement Branch (ASOMB) labs and Flow Physics and Controls Branch (FPCB) flow facilities.

Deliverables and Schedule: The Contractor shall provide:

1. Various hardware components associated with the testing of direct and indirect shear stress sensors.
2. Mechanical drawings of all constructed components in DXF format;
3. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Ongoing through task order completion

Performance Metrics/Standards:
Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 2.3 will be based on the following:

- Fabricated components shall meet all specifications provided by drawings supplied by NASA within the contracted cost.
- Deliverables shall all be received for timely implementation to meet LaRC mission objectives

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 2.3.

- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than required for implementation to meet LaRC mission objectives

2.4. High-Speed Flow Generator (HFG) and Low Speed Flow Diagnostics Facility (LSFDF): Evaluate condition of, fabricate components for, and maintain High-Speed Flow Generator (HFG) and assist with modifications/maintenance of ASOMB low speed flow diagnostics facility (LSFDF).

Deliverables and Schedule: The Contractor shall provide:

1. Report on the current condition of the HFG and what is needed to make operational;
2. Miscellaneous hardware needed to support testing in HFG and LSFDF;
3. Maintenance schedule for the HFG;
4. Mechanical drawings of all constructed components in DXF format;
5. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Ongoing through task order completion

Performance Metrics/Standards:
Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 2.4 will be based on the following:

- Fabricated components shall meet all specifications provided by drawings supplied by NASA within the contracted cost.
- Deliverables shall all be received for timely implementation to meet LaRC mission objectives

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 2.4.

- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than required for implementation to meet LaRC mission objectives

2.5. Machine Shop Maintenance: Maintain the machine shop so that all equipment is safely operational and that a stock of cutting blades, bits and tools are available for the band saw, milling machine and lathe respectively. Maintain the milling machine within calibration as specified by LMS-TD-0529. Maintain a stock of standard nuts, bolts, screws (cap, flat head, round head), and washers (flat and lock) organized according to size in the shop cabinets. The Contractor shall provide:

(a) Inventories of cutting blades, bits and tools;
(b) Inventories of screw and washer stock.

Deliverables and Schedule: The Contractor shall provide:

1. Inventory list of cutting blades, bits and tools on a quarterly basis;
2. Inventory list of screw and washer stock on a quarterly basis;
3. Requests for purchase of cutting blades, bits, tools, screws, and washers as needed to maintain the needed stock
4. Documentation describing the calibration of the milling machine as directed by LMS-TD-0529.

Schedule of Deliverables: Ongoing through task order completion

Performance Metrics/Standards:
Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 2.5 will be based on the following:

- Maintenance of shop inventory at levels that support LaRC mission objectives.
- Maintenance of the milling machine calibration per LMS-TD-0529.
- Deliverables all received for timely implementation of LaRC mission objectives

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 2.5.

- Maintaining the shop inventory in a neat and organized manner with a complete stock sufficient to satisfy normal usage within the budgeted time and dollars.

Begin [R1] block addition

2.6. Technique Compatibility Improvement: Investigate methods for making techniques more compatible for use in unified testing. The Contractor shall determine methods for improving compatibility of various measurement techniques. The Contractor shall develop an implementation plan for suggested improvements.

Deliverables and Schedule:
The Contractor shall provide: report of methods and implementation plan.

Schedule of Deliverables: Ongoing through task order completion

Performance Metrics/Standards:
Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 2.6 will be based on the following:

- Deliverables received by the end of the award fee period in which the improvements were determined

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 6.

- Deliverables received two weeks before the end of the award fee period in which the improvements were determined

End R1 block addition

2.n Working Environment Safety and Organization
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:
Building 1200, Rooms 103 and 115.

Specialized Shop Equipment Milling machine, drill press, lathe, grinder, band saw
Computer
Printers Color laser jet, E-size ink jet printer

Contractor will have access to Government facilities and equipment required to support this task.

4. **Other Essential Information**: In order to perform subtasks in a timely manner, material purchase may be required.

5. Security Clearance: All work will be unclassified

6. Period of Performance:

Planned start date: R1January 25, 2007 Completion date: R1~~December 31, 2007~~
R2~~December 31, 2008~~
December 31, 2009

TASK ORDER NUMBER: 044D3-NNL07AM65T Revision: 2 Change: 0 Date: June 6, 2008

Title: Measurement Science Support

7. NASA Task Management:

Technical Monitor (Required): Kenneth Wright
M/S: 493 Phone: 757-864-4665

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

TASK ORDER NUMBER: 045D3-NNL07AM66T Revision: 2 Change: 0 Date: January 25, 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. The specific task is the *computational evaluation of surface geometry fidelity requirements for accurate flow analysis of supersonic vehicles.*

Revision 1 (6/22/07): Extends the period of performance six months to March 31, 2008 in continuation of NASA's support requirements, documents a Technical Monitor added earlier (1/31/07), and updates the initial task order start date to January 25, 2007 (see R1 below).

Revision 2 (01/25/08): Shortens the period of performance two months to January 31, 2008 due to NASA's programmatic goals being accomplished earlier than anticipated (see R2 below, Section 6).

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

2.1 Computational evaluation of surface geometry fidelity requirements for accurate flow analysis of supersonic vehicles.

There is a need to evaluate the level of fidelity required in representing aircraft geometry in conceptual design models to ensure that there is sufficient surface definition accuracy for use in generating related unstructured grids for CFD analysis. To help address this need, the CONTRACTOR SHALL generate up to 30 unstructured CFD grids from conceptual design geometry models with varying levels of fidelity. Using these grids, the CONTRACTOR SHALL obtain up to a total of 150 flow analyses using the USM3D flow solver. The Government will provide the conceptual design geometry models.

2.1.1 Milestones:

a) Complete grids and analyses for simple components (e.g., wing, fuselage) by 3/30/07.
b) Complete grids and analyses for complex configurations by 9/28/07.

2.1.2 Deliverables:

a) Log of files used in grid generation and flow analysis along with the associated files.
b) Summary of key parameters from the flow analysis results along with the flow field and convergence history files.
c) Limited plots (maximum of 5 per analysis) of selected flow characteristics in Tecplot format and the associated input files.

2.1.3 Performance Metrics/Standard and Schedule:

Minimum acceptable performance (MAP)/Schedule:

a) Complete grids and analysis for simple components (e.g., wing, fuselage) by 3/30/07.
b) Complete grids and analysis for complex configurations by 9/28/07.

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 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 furnish office space and high-end graphic workstation, grid generation codes and documentation, flow solver codes and documentation, and graphic post processing codes and documentation, access to advanced supercomputers if needed, access to PC clusters, geometry surface definitions, aerodynamic data sets, configuration definitions and specific study objectives.

4. Other Essential Information:

None.

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: R1 January 25, 2007 Completion date: R1 ~~September 28, 2007~~ R2 ~~March 31, 2008~~ ***January 31, 2008***

7. NASA Task Management:

Technical Monitor: Richard L. Campbell
M/S: 499 Phone: 757-864-2872

R1 **Technical Monitor (Required): Linda S. Bangert**
M/S: 267 Phone: 757 864-3022

Other POC: Melissa B. Carter
M/S: 499 Phone: 757-864-8606

TASK ORDER NUMBER: 001D4-NNL07AM67T Revision: 2 Change: 0 Date: July 7, 2008

Title: Cryogenic Tunnel Performance Analysis and Operational Enhancements

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01RGO)

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 requires advanced experimental research techniques and operations. The performance of this facility and its systems require frequent analysis with a view to improve and/or increase operational capabilities.

This task deals with innovative research and developmental support needed to analyze current aerodynamic, structural performance of this cryogenic tunnel to improve, optimize and enhance its current operational limits and provide new testing capabilities.

Revision 1 (12/20/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, clarifies safety and organization Subtask 2.n, adds requirements as new Subtasks 2.d through 2.g, and adds other clarifying details including status of 2.b and 2.c (see [R1] below).

Revision 2 (7/7/08): Adds requirements as new Subtask 2.1.h with a new deliverable and extends the period of performance 12 months to December 31, 2009. Note: Due to current organizational activity with Ground Facilities and Testing Directorate (GFTD), other detailed requirements will be defined later with deliverables and schedule for CY09. For funding and planning purposes it is anticipated that staffing requirements will be the same as currently needed for remainder of CY08 (see [R2] below).

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

2.1 NTF [R1] and Other Tunnel Support:

a) [R1] NTF Air mode Mach number The NTF Air mode Mach number is presently limited to 1.08 and the desire is to obtain a higher Mach number limit of M=1.2.
   - The Contractor shall analyze the current performance limitations imposed by fan pressure ratio and test section geometry using operational data and recommend methods and engineering solutions for realizing M=1.2 in Air mode.

b) [R1] NTF Small Amplitude Model Vibrations [R1] (Continued in 2.1.e, below)

c) [R1] NASA AMES 11ft Tunnel Model Vibrations [R1] (Completed)

Begin [R1] block addition

d) Semi-span Flow Control Capability at the National Transonic Facility
   - The Contractor shall work with the NASA Researchers/Programs and NTF operations staff (ROME) to provide a detailed design of a High Pressure Air Supply system to the NTF Sidewall Model Support Mechanism for Semi-span Model flow-Control/Powered-Lift applications.

e) Development of Active Damping System With the recent demonstrated success of the Active Damping system using embedded piezoceramics actuators (AIAA 2007-961, AIAA 2008-0840) there is a strong desire from the NASA's Fundamental Aeronautics Program, Aeronautics Test Program and Industry researchers for further development.

   - The Contractor shall work with the NASA and the NTF operations staff to continue to develop and refine/improve the performance of the existing sting-tip damper. From this work the

Contractor shall provide a design for an Active Damping System that can be used at cryogenic temperatures.

- Using the lessons learned from the existing sting-root damper the Contractor shall provide a design that can be integrated into a Boeing designed upper-swept sting for testing at the NTF. This sting-root damper can be initially designed for ambient temperature operations but the final goal shall be to provide a system that can be used at cryogenic temperatures.

f) Process Improvements at the National Transonic Facility

- The Contractor shall work with the NASA Researchers and NTF operations staff (ROME) by **providing** inputs into the experimental design, testing, data analysis and recommend changes to the facility for improvements to data quality and repeatability. This work may include **proposed** changes or improvements to Mach number, temperature and pressure measurements and control techniques. Additionally, there may be **proposed** structural and/or circuit flow changes that can provide additional improvements to data quality and repeatability.

- To enable adjustment for the recent addition of a new liquid nitrogen plant and new testing techniques at warmer conditions at the National Transonic Facility, the Contractor shall provide a detailed analysis and simulation of a tunnel cool down that is optimized for mitigation of moisture, liquid nitrogen consumption, other thermal issues associated with data quality and duration for final cool down temperatures. The targeted final cool down temperatures are 0°F, -50°F, -100°F, -200°F and -250°F.

g) Facility Overview and Safety Video Development

- The Contractor shall work with the current LaRC Video Services support contractor and the Facility Managers to develop for each of the LaRC major facilities (NTF, TDT, 14x22, UPWT, LAL, 8ft HTT and VST) an overview/orientation video. In this video the Contractor shall provide development of a narrative script and image selection. The Contractor shall coordinate and direct the integration of these components into a final video for each facility.

End R1 block addition

*****Begin R2 block addition*****

h) Direct Connect Supersonic Combustion Test Facility Risk Assessment

- The Contractor shall perform analyses to support a risk assessment of the potential presence of combustible fuel/air mixtures (due to fuel leaks) in the Direct Connect Supersonic Combustion Test Facility. The Contractor shall study the facility configuration, relevant systems (nitrogen, hydrogen, ehtylene, liquid JP, forced ventillation), facility operations, and mitigating systems and procedures. Analyses of potential leak sources, leak rates, leak durations and diffusion/mixing shall be performed to assess the potential for, and quantity of, any potential combustible fuel/air mixtures. The magnitude of Test Cell over-pressure shall be determined in the event that a combustible fuel/air mixture is ignited. Finally, an assessment of the current mitigation strategies against this hazard is to be provided and, if warranted, additional mitigating strategies provided.

*****End R2 block addition*****

2.1.1 Deliverables and Schedule:

The deliverables for the proposed designs and tunnel improvements in the tasks are:

- Design and analysis documents - ongoing
- Cost estimates - ongoing
- Performance/cost trade offs - ongoing

The deliverables for the active damping technology (b and c) are: [R1](Completed)

Begin [R1] block addition

The deliverable for the Semi-span Flow Control Capability (d) is:

- A document that provides the details necessary for fabrication/integration and operation of a High Pressure Air Supply system to the NTF Sidewall Model Support Mechanism for Semi-span Model flow-Control/Powered-Lift applications. This document shall contain initial performance requirements from the NASA Researchers, supporting engineering analysis and/or experimental data analysis, fabrications drawings, necessary parts lists with costs and any performance/cost trade offs. This document shall contain sufficient information for NASA to decide to expand this task in the future to fully develop a High Pressure Air Supply system to the NTF Sidewall Model Support Mechanism for Semi-span Model flow-Control/Powered-Lift applications at the NTF. – December 31, 2008

The deliverables for Development of Active Damping System (e) are:

- A document that provides the details necessary for fabrication/purchase of a Cryogenic Sting-tip Active Damping System. This document shall contain supporting engineering analysis and/or experimental data analysis, fabrications drawings, necessary parts lists with costs and any performance/cost trade offs. This document shall contain sufficient information for NASA to decide to expand this task in the future to fabricate/purchase and test a Cryogenic Sting-tip Active Damping System at the NTF. - December 31, 2008
- A document that provides the details necessary for fabrication/purchase of a Sting-root Active Damping System. This document shall contain supporting engineering analysis and/or experimental data analysis, fabrications drawings, necessary parts lists with costs and any performance/cost trade offs. This document shall contain sufficient information for NASA to decide to expand this task in the future to fabricate/purchase and test a Sting-root Active Damping System at the NTF. – December 31, 2008

The deliverables for NTF Process Improvements (f) are:

- A series of documents that provide details of the proposed change or changes. These documents shall contain supporting analysis and/or experimental data analysis, any performance/cost trade offs and preliminary cost estimates. – December 31, 2008
- A series of documents that provide details of the proposed optimized cool down. The document shall contain supporting analysis and/or experimental data analysis, any performance/cost trade offs analysis. – December 31, 2008

The deliverable for Video Development (g) is:

- Complete narrative script and images that can be developed into an overview/operational video for each of the LaRC major facilities. – December 31, 2008

[R2>]***The deliverable for Risk Assessment (h) is:***

- ***Informal report – December 31, 2008***[<R2]

End [R1] block addition

2.1.2 Performance Metrics/Standards: (See "System and Software Metrics for Performance-Based Contracting")

Minimum acceptable performance

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

Exceeds acceptable performance

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

2.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:

Access to the following Bldgs. 1242, 1236, 1212, 1251, 582:

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

4. Other 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.

5. Security Clearance:

Work on classified projects may be required.

6. Period of Performance:

Planned start date: [R1]January 25, 2007 Completion date: [R1]~~December 31, 2007~~

[R2]~~December 31, 2008~~

December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): W. Allen Kilgore

M/S: 267 Phone: 757-864-5033

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 002E1-NNL07AM68T Revision: 5 Change: 0 Date: January 26, 2009

Title: Programs/Projects Schedules Management and Reporting for ARD

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task orders 01A3 & 01E1A)

Revision 1 (2/23/07): Adds program clarifications and updates to Subtasks 1 and 2, redefines requirements of Subtask 3, and adds potential training, conference, and non-standard work schedule requirements (see [R1] below).
Revision 2 (8/22/07): Extends the period of performance 12 months to December 31, 2008 in continuation of NASA's support, updates the initial task order start date to January 25, 2007, and clarifies safety and organization Subtask 2.n (see [R2] below, Section 6)
Revision 3 (2/27/08): Updates Subtask 1, 2, and 4 requirements in detail; clarifies Subtask 3, Standard 1, and ad hoc training requirements; documents Technical Monitor change and adds Alternate POC. (Note: For historical details deleted for clarity and/or convenience, see previous versions of this PWS located on the electronic task order system (ETOS) as "doc" files *002E1R0C0*, *002E1R1C0*, and *002E1R2C0*. For current updates and clarifications, see [R3] below.)
Revision 4 (12/16/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support and documents an earlier change in the Technical Monitor (see [R4] below, Sections 6 and 7). Note: This action enables nominal re-planning of the work at the current activity level to avoid work stoppage while the detailed requirements are being finalized.
Revision 5 (1/26/09): Deletes previous Subtask 2, renumbers Subtask 3 to 2, adds new Subtask 3, updates Subtask 4 extensively, and makes various clarifications and updates, including NASA POC info (see [R5] below).

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

General Requirements

Begin [R3] block detailed update

2.1 Subtask 1 – [R1]Fundamental Aeronautics Program (FAP) - The Contractor, using [R1]FAP approved scheduling software, shall be responsible for developing and maintaining the detailed schedules for the major projects in [R1]FAP. The Contractor shall establish and maintain baselines for each of these projects. The Contractor shall establish logic networks [R5>]***for each project. Contractor shall work to maintain data integrity between the master schedules and presentation materials for the projects. - The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the [R1]FAP Program representatives, upon request.***[<R5]

Deliverables:

- [R5>]***As Needed***[<R5] - Create, maintain, and make available the milestone registry
- Monthly- Provide status on milestone and activity progress; document issues, weakness, and/or areas that require additional oversight.
- Annually – Provide recommended changes to the Project's baseline schedule
- [R5>]***As Needed - Deliver hardcopy of logic network plots and/or gantt charts***[<R5]
- As Needed - Post all deliverables on identified web based sight for the Projects
- As Needed - Attendance of weekly and monthly meetings and teleconferences; and planning team scheduled meetings
- As Needed – Work with the Program Business Team

2.2 Subtask 2 – Langley [R1]Reimbursable Work ([R5]*Deleted)*

[R5>]**2.2 Subtask 2**[<R5] **(previous 2.3 Subtask 3) – Airspace Systems Program (ASP)-** The Contractor shall provide support consistent with serving as Lead Scheduler for both the [R5]***NextGen*** Airspace and [R5]***NextGen*** Airportal Projects. The Contractor, using Program approved scheduling software, shall be responsible to

develop [R5>]~~and integrate~~[<R5] the detailed schedules containing all tasks and milestones for the Airspace and Airportal Projects. This shall also include an integrated schedule for the Airspace Systems Program if required by the ASP. The Contractor shall establish and maintain baselines for each of these projects. The Contractor shall establish logic networks [R5>]~~and identify the critical path~~[<R5] for each project. The Contractor shall work to maintain data integrity between the master schedules and presentation materials for the projects. The Aeronautics Project Office at Ames will provide scheduling support to meet Ames Research Center [R3>]Project Management[<R3] requirements. [R3>]The Contractor shall provide data to the Aeronautics Project Office at Ames but shall not be responsible for Ames center level data reporting[<R3]. Information and data required for the development and ongoing maintenance of the project schedules shall flow/transfer between Centers. Information shall be provided in a format that allows for manipulation and use by schedulers at either Center. The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the Program. [R5>]~~upon request, such requests should be for the sole purpose of subsequent benefits to the Program.~~[<R5]

Deliverables:

- [R3>]As Needed[<R3] - Management Report for each [R3]AS Project
- As Needed – Management Report for the [R3]AS Program
- As Needed – Create and update the Schedule Documents [R3>]for both projects and a roll-up for the Program[<R3]
- As Needed - Deliver hardcopy [R3>]& electronic versions[<R3] of logic network plots and/or gantt charts as needed
- [R3>]As Needed[<R3] - Provide color electronic copies of all deliverables to each Project Manager and Associate Project Managers
- As Needed - Post all deliverables on identified web based [R3>]site for each Project and the AS Program[<R3]
- As Needed - Attendance all required meetings and teleconferences

End [R1] block redefinition

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

2.3 Subtask 3 – Aviation Safety Program - The Contractor, using Aviation Safety Program approved scheduling software, shall be responsible for developing and maintaining the detailed schedules for the Integrated Resilient Aircraft Control, the Integrated Intelligent Flight Deck Technologies, and the Integrated Vehicle Health Management Projects in the Aviation Safety Program. The Contractor shall establish and maintain baselines for these projects. The Contractor shall establish logic networks for each element and/or theme in these projects. Contractor shall work to maintain data integrity between the overall projects master schedules and presentation materials. The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the Project Manager and/or Associate Project Manager, upon request.

Deliverables:

- As Needed - Maintain and make available the milestone registry
- Monthly- Provide status on milestone and activity progress; document issues, weakness, and/or areas that require additional oversight
- Annually – Provide recommended changes to the Project's baseline schedule
- As Needed - Deliver hardcopy of logic network plots and/or Gantt charts
- As Needed - Post all deliverables on identified web based sight for the Projects
- As Needed - Attendance of weekly and monthly meetings and teleconferences.

*****End R5 block addition*****

Begin R3 block detailed update
*****Begin R5 block detailed update*****
2.4 Subtask 4 – LaRC Aeronautics Research Directorate (ARD)- The Contractor shall provide support to the ARD Director and Deputy Director at Langley Research Center. The Contractor, using ARD approved scheduling software, shall be responsible to develop and maintain the integrated monthly milestone and facility status report for Langley-implemented aeronautics projects (ARMD and reimbursable). The Contractor shall establish and maintain baseline for this report. The Contractor shall work to maintain data integrity between the data sources and the presentation materials for the report. The data required for this subtask will largely be derived under subtasks 1, 2, and 3 and a single point of contact to ARD will integrate and provide this deliverable.

- Initial – Work with ARD Deputy Director and staff to develop monthly report that includes LaRC milestone and facility usage for ARD activities of high value. This report will include milestones for which Langley has significant responsibility for all three ARMD Programs. ARD and Program personnel will aid identification of these milestones. For project milestones requiring facilities the report will allow trace-ability between project milestones, scheduled tests in Langley facilities, and fabrication jobs that provide hardware for facility testing. Interface with schedulers within the NASA ARMD projects, within Langley's Ground Facilities Test Directorate (GFTD), and within Langley's System Engineering Directorate (SED) will provide milestone data, facility test schedules, and list of fabrication jobs. The report will identify schedule risk (days of slack) for fabrication jobs and tunnel test schedules to proactively identify issues requiring Center attention. For this subtask facilities include Langley wind tunnels and the LandIR facility. Fabrication jobs to be tracked include items being built at Langley for offsite testing. Each milestone, facility test, or fabrication job listed shall include the name of the sponsoring project(s) and a project chain point of contact (at the PI, PM, API, or APM level).
- Monthly – Update monthly report, maintaining configuration control, via contact with other project schedulers, SED, and GFTD. The report will include a list of upcoming (next three months) facility test starts, and milestones due as well as facility tests and milestones completed since the last monthly report.
- Monthly – Report and provide positive communication on milestones or activities that require additional review or attention.

*****End R5 block detailed update*****
End R3 block detailed update

Metrics for Subtasks Described above:
Minimum performance standards are to deliver all products on time with the following requirements:
- Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis requirements.
- Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports.
- Once a baseline has been established, changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database that has not been baselined shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation.

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

Standard 1: Develop and deliver Monthly Management Report (MMR) [R3>]as requested.[<R3] The Project/Program MMR follows the project Work Breakdown Structure, and [R5>]*may include,*[<R5] but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis and/or Delinquency Report, and Schedule Status Charts. [R5>]*Note: At times this report may not be required as a monthly deliverable.*[<R5]

CUSTOMER SERVICE/RATING:

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

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

CUSTOMER SERVICE/RATING:

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

Standard 3: Produce and deliver accurate adhoc reports in support of [R5]*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 schedule advice to Program/Projects. This consultation may be in the form of reports or schedule management recommendations.
CUSTOMER SERVICE/RATING:
Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required.
Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required.
Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request.
Poor/Unsatisfactory: When requested, no recommendations are provides to the project management.

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.

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: Program/Project will provide funds to cover travel costs. Program/Project will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract [R1]NNL07AA00B.

Begin [R1] block addition
Special training may be required from time to time. [R3]The Contractor shall provide required training and rationale for training for personnel and provide recommendations to the Technical Monitor. The Technical Monitor shall review the training requirements and coordinate the requirements with Contractor [R3]and fund as appropriate.

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. [R5>]***Recent changes in Agency conference attendance policy will apply.***[<R5]

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

End [R1] block addition

5. Security Clearance: Work under this Statement of Work is unclassified. Security clearances are not required.

6. Period of Performance:

Planned start date: [R2]January 25, 2007 Completion date: [R2]~~December 31, 2007~~ [R4]~~December 31, 2008~~ December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): [R4]Michelle Cohoon-Lawson

M/S: 104 Phone: 757-864-2821

Other POC (Optional): [R5]***Dave Hinton***

M/S: 264 Phone: 757-864-***2040***

TASK ORDER NUMBER: 001E3-NNL07AM69 Revision: 2 Change: 0 Date: September 25, 2008

Title: DACOM, DLH, GFCR, and New Instrument Support for In-flight Test and Science Missions

1. Purpose, Objective, or Background (Optional)

[This task continues work previously conducted under SAMS Task 37RFJ.]

[R1] DACOM and DLH Instrument Support

The work to be conducted under this task supports several existing instruments, as well as instruments under development. The instruments include DACOM (Differential Absorption CO Measurements), DLH (Diode Laser Hygrometer) and GFCR (Gas Filter Correlation Radiometer), as well as prototype instruments utilizing diode laser absorption or gas filter correlation techniques. Additional work may be required on diode laser sensors for combustion environments.

Open Path Sensor C&I Project

The NASA Langley Research Center's Creativity and Innovation program has funded the development of a prototype open-path diode laser absorption sensor for use on a variety of airborne platforms. Initial development is focused on the measurement of hydrogen fluoride (HF) in the stratosphere, most likely from either the NASA/UND DC-8 aircraft or the NSF/NCAR HIAPER aircraft. Under this task, a prototype sensor will be built and tested in laboratories in the Science Directorate. Further work to integrate and test this sensor in flight may be added to this task, pending availability of funds.

GFCR C&I Project

The NASA Langley Research Center's Creativity and Innovation program has funded a feasibility study to determine the potential of making global measurements of boundary layer (BL) carbon monoxide (CO) from low-earth-orbit. Sensitivity to BL CO requires the development of a high precision satellite sensor that would detect reflected solar radiation within the 2.3 micron CO overtone band. This spectral region is extremely challenging due to the weak absorption by CO, the overlap of interfering gas spectra and the strong variability of surface reflection of the solar spectrum. Work under the TEAMS contract will focus on the development and demonstration of a prototype to investigate Gas Filter Correlation Radiometry (GFCR) technology to suppress measurement noise due to rapidly varying background reflectivity. These tests are best carried out by developing a prototype that detects methane (CH_4) in the 2.2 micron band. Results from tests carried out measuring CH_4 (a gas with relatively constant tropospheric concentration) may then be extrapolated to 2.3 micron measurements of CO.

Revision 1 (8/9/07): Adds requirements and/or clarifications including new Subtasks 2.7 and 2.8 and travel, updates the initial task order start date to January 25, 2007, and extends the period of performance 12 months to December 31, 2008 (see [R1] above and below).

Revision 2 (9/25/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support with added requirements as new Subtasks 2.10 through 2.12, including travel and information only Subtask 9, and clarifies safety and organization Subtask 2.n (see [R2] below).

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

2.1 Calibration / Characterization of Diode Laser Hygrometer I and II :

The DLH-I and –II both require recharacterization following recent field studies. As they utilize nearly identical hardware and software, these characterizations will be done in succession without dismantling the assembly.

The Contractor shall assemble DLH-I and -II in calibration configuration. This assembly shall include all supporting instrumentation, plumbing, electrical and data acquisition equipment necessary. The Contractor shall operate supporting equipment during calibration / characterization activities

2.1.1 Deliverables:

Calibration / Characterization assembly completed, with documentation drawings. Drawings shall include sketch of configuration and model/serial numbers and calibration status (if available) for all supporting components.

2.1.2 Performance Metrics/Standards:

Meets: DLH-I calibration assembly complete by Feb. 8, 2007.
DLH-II calibration assembly complete by Mar. 8, 2007.
Exceeds: DLH-I calibration assembly complete by Feb. 1, 2007.
DLH-II calibration assembly complete by Mar. 1, 2007.

2.2 Construction of Prototype HF [R1] and Water Vapor Instruments:

Fabrication of prototype instrument hardware to incorporate new 2.475 micron DFB laser for use in sensing of atmospheric hydrogen fluoride (HF). This hardware shall be largely platform-independent and incorporate already completed developments, as feasible and appropriate. Prototype should be compatible with operation on DC-8 aircraft. Contractor shall recommend use of off-the-shelf components whenever feasible.

Begin [R1] block addition
Fabrication of prototype instrument water vapor instrument (DLH-III) to allow use of new 1.4 micron fiber-coupled DFB laser, received during summer 2007. This prototype shall be constructed in the manner described above, and is planned to be flown, pending availability of opportunity, on the DC-8 during calendar year 2008.
End [R1] block addition

2.2.1 Deliverables

Prototype HF instrument.
[R1]Prototype water vapor instrument

2.2.2 Performance Metrics/Standards

Meets: Instrument complete by March 31, 2007, providing that all components are available by January 31, 2007.
[R1]Water vapor instrument complete by January 31, 2008.
Exceeds: Instrument complete by March 1, 2007, providing that all components are available by January 31, 2007.
[R1]Water vapor instrument complete by December 31, 2007.

2.3 Laboratory Testing of Prototype HF Instrument:

Prototype instrument shall be tested in the laboratory using existing HF cells. Testing shall confirm proper operation of laser (and its supporting electronic subsystems) and detectors (and their supporting electronic subsystems).

2.3.1 Deliverables

Report documenting performance of prototype instrument.

2.3.2 Performance Metrics/Standards

Meets: Testing complete by April 30, 2007, contingent on success of subtask 2.2.
Exceeds: Testing complete by April 15, 2007, contingent on success of subtask 2.2.

2.4 Ground and Flight Testing of Phase-A Prototype GFCR Sensor:

Experimental demonstration/tests of phase-A prototype sensor performance shall be conducted on the ground and in-flight. Prior to flight tests, the GFCR instrument shall be integrated on the NASA Wallops P-3 aircraft. Flight-based experiments demonstrating telescope and detector performance of the phase-A prototype shall be conducted according to the aircraft flight schedule, estimated to be January and February 2007.

2.4.1 Deliverables

Documentation of phase-A prototype performance during ground-based tests.
GFCR phase-A prototype installed on P-3 aircraft.
Documentation of phase-A prototype performance during in-flight tests.

2.4.2 Performance Standards and Evaluation Criteria

Meets: Ground tests complete and documentation provided prior to beginning of flight tests.
Flight test documentation provided within 1 month of completion of flight tests.
Exceeds: Ground tests complete and documentation provided two weeks prior to start of flight tests.
Flight test documentation provided within two weeks of completion of flight tests.

2.5 Assembly and Ground / Flight Testing of Phase-B Prototype GFCR Sensor:

The phase-B prototype sensor shall be assembled and aligned. Experimental demonstration/tests of phase-B prototype sensor performance shall be conducted on the ground and in-flight. Prior to flight tests, the GFCR instrument shall be integrated on the NASA Wallops P-3 aircraft. Flight-based experiments demonstrating column measurement sensitivity of the phase-B prototype shall be conducted according to the aircraft flight schedule, estimated to be July and August 2007.

2.5.1 Deliverables

Assembled and aligned phase-B prototype sensor.
Documentation of phase-B prototype performance during ground-based tests.
GFCR phase-B prototype installed on P-3 aircraft.
Documentation of phase-B prototype performance during in-flight tests.

2.5.2 Performance Standards and Evaluation Criteria

Meets: Assembled/aligned phase-B prototype completed two weeks before aircraft integration.
Ground tests complete and documentation provided prior to beginning of flight tests.
Flight test documentation provided within 1 month of completion of flight tests.
Exceeds: Assembled/aligned phase-B prototype completed four weeks before aircraft integration.
Ground tests complete and documentation provided two weeks prior to start of flight tests.
Flight test documentation provided within two weeks of completion of flight tests.

2.6 Testing and Modification of the DACOM Instrument:

Minor anomalies have been found in the operation of the DACOM instrument during recent field campaigns, and these anomalies have been attributed to a combination of causes, primarily interactions between channels in the electronic subsystem and varying optical interferences associated with changes in aircraft cabin pressure. The contractor shall investigate these anomalies and recommend solutions. The recommendations shall be implemented within budgetary and scheduling limitations.

2.6.1 Deliverables

Documentation of sources of anomalies found.
Documentation of recommended solutions.
Implementation of recommended solutions, within constraints of funding and schedule.

2.6.2 Performance Standards and Evaluation Criteria

Meets: Anomalies documented and solutions recommended by April 15, 2007.
Solutions implemented by May 15, 2007, pending availability of funds.
Exceeds: Anomalies documented and solutions recommended by April 1, 2007.
Solutions implemented by May 1, 2007, pending availability of funds.

Begin [R1] block addition

2.7 Preparation of DACOM and DLH for ARCTAS mission:

The DACOM and DLH instruments are expected to be flown as part of the 2008 ARCTAS field campaign, which are a part of the International Polar Year scientific activities. The Contractor shall perform re-characterization, maintenance, minor modifications, and preparation for redeployment on the instruments following their return from the TC4 field campaign in August 2007.

2.7.1 Deliverables

Documentation of re-characterization findings.

Documentation of maintenance performed.
Documentation of recommended modifications
Instrument status and shipping documentation.

2.7.2 Performance Standards and Evaluation Criteria

Meets: Re-characterization documented by October 31, 2007.
Maintenance performed by November 30, 2007.
Modifications recommended by December 31, 2007.
Modifications made by January 31, 2008.
Preparations for shipping completed 1 day prior to ship date.

Exceeds: Re-characterization documented by October 17, 2007.
Maintenance performed by November 16, 2007.
Modifications recommended by December 17, 2007.
Modifications made by January 31, 2008.
Preparations for shipping completed 2 weeks prior to ship date.

2.8 Participation in ARCTAS field campaign:

The ARCTAS field campaign will necessitate participation at a remote integration site and/or deployment site(s) to be determined. The Contractor's participation shall include travel to remote sites, integration of instrumentation aboard DC-8 aircraft, test flight evaluations, and field deployment. The Contractor shall perform preliminary data reduction.

2.8.1 Deliverables

Documentation of integration status and issues.
Archiving of field data.

2.8.2 Performance Standards and Evaluation Criteria

Meets: Instruments integrated on aircraft one week prior to first test flight.
Preliminary flight data archived within 24 hours of flight completion for 75% of flights.
Exceeds: Instruments integrated on aircraft two weeks prior to first test flight.
Preliminary flight data archived within 24 hours of flight completion for 95% of flights.

End [R1] block addition

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

NOTE: The work described in 2.9 below clarifies the work that was completed under 2.2 above and is given below to show the connection with the follow-on work of 2.10 through 2.12.

****Begin Information only Section****

2.9 Preparation of DLH-WB for NOVICE mission:

The DLH-WB instrument is expected to be flown as part of the 2008 NOVICE field campaign. The Contractor shall perform mechanical, electronic, and software design as well as small-parts fabrication and *instrument assembly, and preparation for deployment on the WB-57 aircraft. The Contractor shall prepare the instrument for shipping to Houston, TX.*

2.9.1 Deliverables
Mechanical design files.
Electronic design drawings.
Computer software for controlling and operating instrument.
Completed instrument.
Instrument status and shipping documentation.

2.9.2 Performance Standards and Evaluation Criteria
Meets: Mechanical design completed by August 31, 2008.
Electronic design completed by August 31, 2008.
Computer software completed by September 5, 2008.
Instrument build completed by September 5, 2008.
Preparations for shipping completed 1 day prior to ship date.

Exceeds: Mechanical design completed by August 17, 2008.
Electronic design completed by August 17, 2008.
Computer software completed by September 1, 2008.
Instrument build completed by September 1, 2008.
Preparations for shipping completed 1 week prior to ship date.
****End Information only Section****

2.10 Participation in NOVICE field campaign:

The NOVICE field campaign will necessitate participation at a NASA Johnson / Ellington Field in Houston, TX during September 2008. The Contractor's participation shall include travel to Houston, integration of instrumentation aboard WB-57 aircraft, and test flight evaluations and maintenance. The Contractor shall conduct preliminary data analysis.

2.10.1 Deliverables
Documentation of integration status and issues.
Archiving of field data.

2.10.2 Performance Standards and Evaluation Criteria
Meets: Instruments integrated on aircraft one day prior to first test flight.
Preliminary flight data submitted to Technical Monitor within 24 hours of flight completion for 75% of flights.
Exceeds: Instruments integrated on aircraft two days prior to first test flight.
Preliminary flight data submitted to Technical Monitor within 24 hours of flight completion for 95% of flights.

2.11 Preparation of DLH-WB for NOVICE-follow-on mission:

The DLH-WB instrument is expected to be flown as part of a follow-on to the 2008 NOVICE field campaign, expected to take place in January, 2009. The Contractor shall perform mechanical, electronic, and software modifications as necessary, and prepare the instrument for deployment on the WB-57 aircraft. The contractor shall prepare the instrument for shipping to Houston, TX.

2.11.1 Deliverables

Documentation of mechanical, electronic, and software modifications as necessary.

Instrument status and shipping documentation.

2.11.2 Performance Standards and Evaluation Criteria

Meets: Modifications complete and documented two weeks prior to shipping date (TBD).
Preparations for shipping completed one day prior to ship date.

Exceeds: Modifications complete and documented one week prior to shipping date (TBD).
Preparations for shipping completed one week prior to ship date.

2.12 Participation in NOVICE-follow-on field campaign:

The NOVICE-follow-on field campaign will necessitate participation at a NASA Johnson / Ellington Field in Houston, TX during January, 2009 (actual dates TBD). The Contractor's participation shall include travel to Houston, integration of instrumentation aboard WB-57 aircraft, and test flight evaluations and maintenance. The Contractor shall conduct preliminary data analysis.

2.12.1 Deliverables

Documentation of integration status and issues.

Archiving of field data.

2.12.2 Performance Standards and Evaluation Criteria

Meets: Instruments integrated on aircraft one day prior to first test flight.
Preliminary flight data submitted to Technical Monitor within 24 hours of flight completion for 75% of flights.

Exceeds: Instruments integrated on aircraft two days prior to first test flight.
Preliminary flight data submitted to Technical Monitor within 24 hours of flight completion for 95% of flights.

*****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***.

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. The DACOM and DLH instruments as well as supporting instrumentation, flight racks, shipping containers, hardware, software, and manuals. Access will be available to standard tools and lab test equipment (e.g. meters and oscilloscopes).
2. Hardware required for fabrication of prototype instruments.
3. Laboratory facilities for instrument checkout are available in rooms 114 and 115 of Building 1250.
4. Government to furnish existing documentation, including notebooks, AutoCAD schematics, etc.
5. Computers, telephones, office space, typical office supplies.

4. Other Essential Information:

Travel for GFCR integration and flight tests is estimated to be:

a) Eight 1-day trips to NASA Wallops for two people.
b) Eight 2-day trips to NASA Wallops for two people.

In order to perform the task in a timely manner, it may occasionally be necessary for the Contractor to purchase material items.

Begin R1 block addition

Travel for ARCTAS campaign estimated to be:

(a) Two 14-day trips to Palmdale, CA, for two people.
(b) One 7-day trip to Fairbanks, AK, for two people.

End R1 block addition

Begin R2 block addition

Travel for NOVICE campaign estimated to be:

(c) One 14-day trip to Houston, TX, for two people.

Travel for NOVICE-followon campaign estimated to be:

(d) One 14-day trip to Houston, TX, for two people.

End R2 block addition

Safety: All personnel must have a current *Laser Eye Safety Certification* from LaRC.

5. Security Clearance:

None required.

6. Period of Performance:

Planned start date: R1 January 25, 2007 Completion date: R1 ~~December 31, 2007~~
R2 ~~December 31,2008~~
December 31, 2009

7. NASA Task Management:

Technical Monitor (Required): Glenn S. Diskin

M/S: 483 Phone: 864-6268

Other POC (Optional):

M/S: Phone:

TASK ORDER NUMBER: 004E4-NNL07AM70T Revision: 3 Change: 0 Date: August 28, 2008

Title: Advanced Space Transportation Systems' Aerodynamic, Aeroheating, Thermal Protection System, and Systems Analysis

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 08RAA)
NASA's Langley Research Center – Vehicle Analysis Branch (VAB) develops and applies computer aided tools in the system analysis of advanced space transportation systems. Engineering disciples include geometry, weights and sizing, aerodynamics aeroheating, propulsion, trajectories, Thermal Protection System (TPS), structures, costs, and operations. Contract support is needed, primarily:

(a) To provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems, and

(b) To perform analyses in selected disciplinary areas.

Products from these efforts include study results, analysis methods and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computers. Currently, the primary computational platforms are Apple OS, Windows, and SGI/UNIX based PCs which host engineering codes critical to the systems analysis work. Security clearances (Secret level) may be needed in some instances. Specific requirements, deliverables with dates, metrics, and furnished materials are described below.

Revision 1 (7/30/07): Updates the reduced anticipated support for Subtask 2.3--noting that the next (and final) planned revision of the Cost Estimating Relationships (CERs) is due next May with decreased activity until then. Also updates the initial task order start date to January 25, 2007 (see [R1] below).

Revision 2 (10/30/07): Terminates Subtask 2.3 at COB 12/31/07, continues Subtasks 2.1 and 2.2 through 12/31/08, and clarifies safety and organization Subtask 2.n (see [R2] below).

Revision 3 (8/28/08): Extends the period of performance 12 months to December 31, 2009 in continuation of NASA's support (see [R3] below).

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

2.1 (Requirement/subtask number one):

2.1.1 Milestones (Optional):

2.1.2 Deliverables and Schedule (Required):

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

2.1.0 Maintenance and Development of Aerodynamic, Aeroheating, and TPS Analysis Tools

The Contractor shall perform the following requirements:

2.1.1 Maintain and ensure proper performance of aero family of analysis tools (MINIVER, INCHES, APAS, KISS, CMA, FIAT, TPS-it, RIFSP, and AVSL) and their support utilities collectively known as the "aero tools". The Contractor shall fix software bugs and problems resulting from modeling errors, programming techniques, or operating system changes. All software deliverables will be consistent with the current programming language for the affected subroutine and/or program, unless a waiver is granted. The Contractor shall produce sample case outputs and demonstrate that the enhanced code is consistent with the previous results. On average, three bug fixes per month and two operating system changes per year are expected.

2.1.2 Provide programming support for aero studies including the development of general purpose and specific computer subroutines of aerodynamics, aeroheating, and TPS models, and integration into of those models into the Adaptive Modeling Language (AML) environment. Programming support tasks can be described as simple model (less than 50 lines of executable FORTRAN code), moderate model (between 50 and 500 lines of executable FORTRAN code), or complex model (over 500 lines of executable FORTRAN code). On average, five simple, two moderate, and one complex task per year are expected. The Contractor shall provide documentation of the software formulation, inputs/outputs, and test cases; and shall produce a user's guide for the above mentioned subroutine models.

2.1.3 The Contractor shall track these changes using configuration management software (e.g. RCS), transition the software to VAB analysts after its completion, and provide user familiarization during the transition.

Deliverables

2.1.1 Fully functional aero tools which are free of known programming errors. When a software bug is identified, the code shall be repaired within one week for a simple model (less than 50 lines of executable FORTRAN code); within two weeks for a moderate model (between 50 and 500 lines of executable FORTRAN code, and within one month complex model (over 500 lines of executable FORTRAN code.). Delivery of error-free programs shall be within one month for operating systems changes and upgrades.

2.1.2 Instruction on use of the new models. Program users will receive instruction within two days for a simple model instruction, within two weeks for a moderate model instruction, and within 1 month for a complex model instruction

2.1.3 Documentation of specific changes and associated modifications within configuration management tools.

Metrics

1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modification as described above.

2. Ability to make any previous version of aero code available within one day of such a request.

3. Usability of the interfaces and enhanced tools as measured by the ability of the VAB analysts to operate the tools easily without assistance.

2.2.0 Aero Tool Transfer to Customers

The Contractor shall perform the following requirements:

2.2.1 Provide for the transfer of aero tools and documentation to customers upon request and shall respond to customer inquiries concerning installation and operation of the tools on the customer's computer.

2.2.2 Maintain a current list of customer contact points to who tools have bee transferred and provide a quarterly update to current users appraising them of the current version of the aero tools and significant changes in these tools.

2.2.3 Provide a monthly status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. Typically such requests are received once every two weeks

Deliverables

2.2.1 Status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete (monthly)

2.2.2 Delivery of software and documentation to customers. (on request)

2.2.3 Updates to current users. (quarterly)

Metrics

Effectiveness of transfers as measured by use of transfer method acceptable to the customer and by successful customer reproduction of output from sample cases which have been run on VAB computers. Timeliness of transfers measured by documentation being prepared for transmittal within two days of receiving the request and completion of the transfer of the aero tools within on wee, unless otherwise specified.

Begin R2 block termination 12/31/07

2.3.0 Operations and Life Cycle Cost R1 See Revision 1& 2 note above (Section 1).

The Contractor shall perform the following operations, maintenance, reliability, and cost analysis requirements:

(a) Support the use of latest version of RMAT to assess the effects of reliability growth of selected subsystems on manpower and turnaround requirements.

(b) Support the latest version of RMAT to assess operations and life cycle costs for Constellation projects.

(d) Provide support for the latest version of the Logistics Cost Model (LCM) through consultation and analysis.

(e) Provide support for the latest version of the RMAT through consultation and analysis.

Deliverables

2.3.1. Status reports on progress of assigned tasks shall be reported on request to support operations and Life Cycle Cost analyses of the VAB.

2.3.2. A task summary report shall be submitted within one month of task completion.

Metrics

Thoroughness of the effort is measured by accuracy and completeness of documentation.

End [R2] block termination 12/31/07

Schedule of Deliverables

Work on this task order is scheduled to conclude [R3R2]~~12/31/07~~ ~~12/31/08~~ ***12/31/09***. Specific deliverables and completion dates for the work breakdown elements are given below.

Element	Deliverable	Date
2.1.1	Fully functional aero tools which are free of known programming errors. When a software bug is identified, the code shall be repaired within one week for a simple model (less than 50 lines of executable FORTRAN code); within two weeks for a moderate model (between 50 and 500 lines of executable FORTRAN code, and within one month complex model (over 500 lines of executable FORTRAN code.). Delivery of error-free programs shall be within one month for operating systems changes and upgrades.	After the identification of a bug
2.1.2	Instruction on use of the new models. Program users will receive instruction within two days for a simple model instruction, within two weeks for a moderate model instruction, and within 1 month for a complex model instruction	After completing a subroutine
2.1.3	Documentation of specific changes and associated modifications within configuration management tools.	After completing a subroutine
2.2.1	Status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete	Monthly
2.2.2	Delivery of software and documentation to customers.	On request
2.2.3	Updates to current users.	Quarterly
[R2]2.3.1	Status reports on progress of assigned tasks shall be reported on request to support operations and Life Cycle Cost analyses of the VAB.	On request
[R2]2.3.2	A task summary report shall be submitted within one month of task completion.	Within one month of task completion

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.

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

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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. Access to Macintosh and Windows PCs, and SGI Unix machines.

2. Access to codes MINIVER, APAS, I-DEAS, INCHES, SMART, TECPLOT, LaTex, VGM, RMAT, KISS, CMA, FIAT, TPS-it, RIFSP, and OCM.

3. Configuration geometry for each assessment vehicle and CAD geometry formats for automated geometry inputs

4. AML visualization, simulation, integration tool, and windows development tools within VAB.

5. Access to FORTRAN compilers for Macintosh and Windows, and SGI/UNIX.

6. Operations data including system and sub-system process flows, reliabilities, and operations cost data.

4. Other Essential Information:

The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the Contractor may:

(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or

(b) Suggest innovative approaches to achieving the task goals that result in time and/or cost savings or an improved product.

5. Security Clearance: Security clearances (Secret level) may be needed in some instances (TBD)

6. Period of Performance:

Planned start date: [R1]January 25, 2007 Completion date: [R2]~~December 31, 2007~~ [R3]~~December 31, 2008~~ ***December 31, 2009***

7. NASA Task Management:

Technical Monitor (Required): Richard W. Brown

M/S: 451 Phone: 757-864-7685

Other POC (Optional):

M/S: Phone:

TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 005E4-NNL07AM71T Revision: 1 Change: 0 Date: September 18, 2007

Title: Advanced Space Systems Concepts Technical and Analytical Support for the Systems Analysis and Concepts Directorate (SACD)

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 12RAB)

Systems Analysis and Concepts Directorate (SACD) is the NASA Langley organization that develops and delivers advanced concepts, systems analyses, and multidisciplinary methods that enable programs to meet objectives and that enable the Agency to develop future aerospace technologies. SACD will support implementation of the NASA Vision for Space Exploration, including (but not limited to): development of alternative Lunar and Mars mission architectures, conceptual design and analysis of associated spacecraft and subsystems, campaign analysis of the alternative architectures, and technology assessments and trade studies.

SACD also supports development and analysis of advanced systems concepts within the LaRC Creativity and Innovation (C&I) initiative, an activity that offers LaRC employees an opportunity to explore new ideas and technologies. The FY04 C&I activity supported by SACD (formerly as ASCAC) was the "Mars Tumbleweed," a study examining the feasibility of using Martian surface winds for rover mobility.

Revision 1 (9/18/07): Updates subtasks 2.1 and 2.2 and travel requirements, deletes all requirements for subtask 2.3, shortens the period of performance one month to November 30, 2007 with the expectation of part-time support, and updates the initial task order start date to January 25, 2007 (see [R1] below).

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

2.1 Communications Architecture and Analysis and SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions) support for [R1]*Lunar Architecture* Exploration missions:

*****Begin [R1] block detailed updates*****

The Contractor shall provide communications architecture and analysis support for Lunar Architecture Exploration mission studies. The Contractor shall work to complete population and updates to the Communications & Navigation Traffic Model Spreadsheets associated with Lunar Architecture Trade options and studies. Also, the Contractor shall enhance and utilize the SPASIM software tool in conducting LAT assessments and analyses, to include modeling of LAT Elements, dynamic simulations and report generation. These enhancements and analyses shall be utilized to define and indicate communications capabilities available for the Exploration mission studies:

(1) Situational analysis of Moon neighborhood communications architectures, Earth Communications Facilities and concepts to support selected Lunar Exploration missions will be used

The result of the effort will support infrastructure definition in communications architectures between the Earth, spacecraft, Lunar orbiting relays and Lunar landers and Constellation Elements. The following capability shall be provided, maintained, updated, and/or improved:

(1) Traffic Model updates for Lunar Architecture Team trade Options: Help populate the Lunar Architecture Team Communications & Navigations Traffic Model requirements as part of the Options trade studies to define the C&N requirements over the timeline buildup evaluations of LAT Options.
(2) Output report modifications and files (readable in Excel) will be generated for all analysis

simulations, to include results that list: (a) a series of output reports that summarize the SPASIM-to-STK modifications and analysis capability, (b) a series of reports that summarize the models for two (2) key architecture elements simulated and analyzed for the Lunar Architecture Team – The Lunar Relay System and the Lunar Communications Terminal. The Contractor will be provided with an example output report format to follow.

(3) Final report documentation shall be provided for all communications analyses performed and SPASIM development in appropriate electronic document format and shall: (a) include a series of reports that summarize the Lunar Exploration Architecture Elements modeled (LRS & LCT); (b) some presentation slides of key analysis results.

(4) The on-line SPASIM manual shall be updated to reflect all changes as of July 31st 2007.

Communications Architecture and Analysis Models, and SPASIM Development Deliverables and Dues Dates

(1) Traffic Model updates and final Excel based version Traffic Model file to be synchronized with the Lunar Architecture Elements' Communications and Navigations Requirements. Includes tabbed placement of worksheets to allow for LAT Options and Element C&N needs (for future use).
Due date: *October 31, 2007*

(2) Final SPASIM output report modifications and files modeled using MATLAB/SIMULINK for LAT Element simulation and data linkage to Satellite Tool Kit. An example output report format will be provided to the contractor to follow
Due date: *November 30, 2007*

(3) Provide final report documentation detailing simulation analyses (Communications, Power, etc..) conducted for Lunar Architecture Elements modeled in SPASIM. An electronic document format will be provided to the Contractor for final reporting and presentation of results.
Due date: *November 30, 2007*

(4) Update the on-line SPASIM manual and SPASIM documentation to reflect all changes as of July 31st, 2007
Due date: *November 30, 2007*

(5) SPASIM version 2.0 Beta – Includes subsystem upgrades w/ hooks for ECLSS simulation/analysis integration.
Due date: *October 31, 2007*

2.2 Environmental Control Life Support System (ECLSS) modeling and simulation capability

The Contractor will incorporate an ECLSS model and simulation capability within the SPASIM tool either as a separate tool or as a link to the existing tool. The Contractor will enhance and utilize the SPASIM software tool to provide an ECLSS modeling, simulation and analysis capability for the purposes of supporting Human systems evaluations for Exploration Mission studies and Lunar Architecture Team studies The Contractor will work with JSC life sciences personnel and others at LaRC to provide a realistic model for an ECLSS system analysis capability for a spacecraft, and will present the end-of-effort results to both JSC and LaRC personnel. The ECLSS system will interact with SPASIM subsystems to provide a simulation and effects capability for crewed vehicles:

(1) The Contractor will develop SPASIM modifications to accommodate crews and models for crew usage and simulation of H20, Oxygen, and Nitrogen systems

(2) The Contractor will effectively model and implement functional pressurization systems for crewed volumes associated with the Constellation Program and the Lunar Architecture Team. Models of ECLSS should be generated separately for the (a) Crew Exploration Vehicle, (b) The Lunar Surface Ascent Module, (c) The Lunar surface Habitation Module, and (d) The Pressurized Lunar Rovers. There should be a functional connection between the ECLSS models for the vehicles listed above and the remaining vehicles' subsystem models and analyses.

(3) The Contractor will provide integrated simulation and analysis with other Spacecraft subsystems affected by the crewed vehicle functional simulation capabilities.

(4) The Contractor will validate the ECLSS functional simulation and analysis models with JSC and LaRC personnel by reviewing examples and conducting crewed vehicle simulations, with results being reported to those persons of interest.

ECLSS modeling and simulation/analysis capability deliverables and due dates:

(1) Final report on ECLSS models implemented in a manual supplement to working version of SPASIM (2.0a Beta), complete with functional summary of the models, parameters, and Test & Validation results.
Due date: ***(Completed)***

(2) Final report and files on ECLSS models implemented for Constellation and the Lunar Architecture Team Elements & Options. Model files of ECLSS systems should be generated separately for ***different phases of a mission, to include: (1) Earth-to-Moon cruise phase; (2) Lunar surface operations phase; and (3) Lunar Ascent phase to Lunar Orbit.*** (a) Crew Exploration Vehicle, (b) The Lunar Surface Ascent Module, (c) The Lunar surface Habitation Module, and (d) The Pressurized Lunar Rovers ***(FRED), and EVA Spacesuits.*** Test & Validation results for each Model

should be generated.
Due date: ***November 30, 2007***

(3) Concept report analyses of Constellation/LAT crewed vehicles in support of functional modeling, simulation and analysis of ECLSS interacting with other spacecraft subsystems for LAT scenario examples, delivered in a Powerpoint presentation file format.
Due date: ***November 30, 2007***

(4) Final candidate concept report analyses, demonstrations and presentation of Constellation/LAT vehicles simulated in support of crewed and lunar modules implementing ECLSS evaluations for scenario examples. This will most likely be a demonstration at NASA JSC. Electronic outline of Presentation format will be provided for use.
Due date: ***November 30, 2007***

(5) SPASIM version 2.0a Beta – Upgrades to SPASIM to include a functional dynamic ECLSS model and simulation capability; Manual upgrades to reflect ECLSS capability.
Due date: ***October 31, 2007***

2.3 Constellation Program Activities

(1) Deleted per new revision

Metrics: (requirements described above)
1. Clarity, completeness, usefulness, and technical soundness of the analyses
2. Coding development efficiency and innovative application to the concept assessment, along with detailed update to the online Users guide in the case of SPASIM.

Standards:
The Contractor will be considered to *meet* the required performance standards if the analyses provide credible results and reports, and the software coding is executable on the Space Missions Analysis Branch (SMAB) computing platforms. The Contractor will be considered to exceed the required performance standards if the results are documented in a presentation form that can be briefed at a conference, and the software coding is user friendly to SMAB personnel (i.e. SPASIM: Users guide is explicit and detailed for use/instruction).
*****End [R1] block detailed updates*****

2.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.

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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 Systems Analysis and Concepts Directorate (SACD) Collaborative Engineering Center (CEC) software and hardware environments. Access to specialized software capabilities of the SACD SMAB , including SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions), [R1]***updated versions*** of MATLAB/SIMULINK, and Satellite Tool Kit (STK). SACD computer hardware environments include SGI workstations and Windows based PCs.

4. Other Essential Information:

[R1]***One trip (2-3 days travel) to NASA JSC in support of the task order work will be required. Approximate date is end of August – Mid-September, 2007.***

5. Security Clearance:

[R1]*N/A*

6. Period of Performance:

Planned start date: [R1]***January 25, 2007*** Completion date: [R1]~~December 31, 2007~~ ***November 30, 2007***

7. NASA Task Management:

Technical Monitor (Required): Frederic H. Stillwagen

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Other POC (Optional):

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TEAMS Task Order Performance Work Statement (PWS)	

TASK ORDER NUMBER: 003E5-NNL07AM72T Revision: 3 Change: 0 Date: September 26, 2008
Title: R2>Exploration and Space Operations Directorate (ESOD) and Flight Projects Directorate (FPD)<R2 Schedule Support

1. Purpose, Objective, or Background (Optional) (Follow-on to SAMS task order 01G1A)

Revision 1 (6/20/07): Extends the period of performance one year in continuation of NASA's support requirements, updates the initial task order start date to January 25, 2007, and clarifies/updates requirements for accuracy (see R1 below).
Revision 2 (5/21/08): Updates organizational references (including the task order title), clarifies safety and organization Subtask 2.n, updates, clarifies, and adds requirements, 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)

General Requirements

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.

Description: Unless otherwise specified, the Contractor shall develop and maintain the Integrated Master Schedule (IMS) for programs and projects as described below in subtask detail. The Contractor shall also develop and maintain detailed schedules and shall coordinate the development and integration of schedules and work breakdown structures at levels established by program management. Any discrepancies that arise between the overall master schedules shall be communicated to the appropriate program/project point of contact (POC). The Contractor shall alert the POC should any discrepancies arise involving major milestones and/or deliverables. The critical path and the resource critical path (if the schedule is resource constrained) shall be identified within the IMS. The Contractor shall produce and deliver a monthly management report and provide consulting and expert advice on schedules to the program or project management. When appropriate, provide program or project with earned value data and analysis and schedule risk assessment.

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

- graphic reports Network Diagrams, Gantt charts, resource histograms
- earned value reports and analysis
- management reports
- analytical reports and "white papers"
- management bullet/presentation charts
- WBS dictionary and/or hierarchical graphs
- Schedule Management Plan required to provide unique analysis or report formats (Primavera, Microsoft Project, etc.)

Metrics:
Minimum performance standards are to deliver all products on time with the following requirements:
a) Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and

can support all management and working level reporting and analysis requirements shall be documented in the Schedule Management Plan for each project.

b) Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports. For this reason, schedules shall be distributed electronically only in either Adobe or Microsoft PowerPoint formats.
c) Once a baseline has been established, changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database, which has not been baselined, shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation. A record of approved baseline changes shall be maintained in a Change Control Log.
d) For new schedule requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation. This assessment and planning activity shall be documented in the Schedule Management Plan.
e) The Contractor shall deliver all deliverables on time. The schedule of deliverables may vary by subtask.
f) Once a baseline master schedule has been approved, the Contractor shall maintain historical plan/actual data as part of the schedule database. The data shall include original duration/actual duration at completion and actual start/actual finish and baseline start and baseline finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects.
g) The schedule shall follow the guidelines established in "NASA Procedural Requirement (NPR) 7120.5x, and the standards established by the Project Management Institute (PMI).

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

CUSTOMER SERVICE/RATING:

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

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

CUSTOMER SERVICE/RATING:

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

Standard 3: Produce and deliver accurate ad hoc reports in support of R2>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 schedule advice to projects identified in the task order as subtasks. This consultation may be in the form of reports (Trend Analysis, Schedule Risk Assessments, Critical Path or Resource Critical Path Analysis, Earned Value Analysis) or schedule management recommendations.

CUSTOMER SERVICE/RATING:

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

Subtask Description: The Contractor shall provide planning and schedule support to develop and manage master and detailed level schedules for the following R2>**Exploration and Space Operations Directorate (ESOD) and Flight Projects Directorate (FPD)**<R2 subtasks. The schedule development and maintenance shall include directing and working with all R2>ESOD and FPD<R2 project, subproject, element, and task managers from LaRC and other NASA centers, as appropriate. The schedules shall be resource loaded, suitable for earned value management and integrated as appropriate to include contractor, NASA led, proposals, and government task agreement schedules.

Subtask Deliverables (To Be Determined by Subtask Project Manager):

- Monthly Management Report—the Contractor shall analyze all schedule information submitted by the contract and government sources and submits a monthly report by the 15th of every month.
- Integrated Master Schedule
- Provide planning and scheduling support for weekly and monthly meetings and teleconferences; attend other program and project meetings as necessary.
- Monthly schedule updates.
- Post updated integrated master and subproject/element/task schedules to an electronic data storage system by the 20th of every month.
- Provide schedule Gantt Charts for Monthly/Quarterly Reviews
- Provide monthly and quarterly timeline schedule of major events.
- As needed – Analyze schedules for conflicts and issues.
- As needed – Project Plan schedules showing Level II, III, and other level milestones as deemed appropriate.
- As needed – Advise the management team on development of the critical path and resource-loaded schedules.

2.1: Subtask 1 – R2>Exploration and Space Operations Directorate and Flight Projects Directorate<R2**:** The Contractor shall provide project planning for the directorate and submit a R1Monthly R2>Master Schedules Report<R2 for all ESOD and FPD projects depicting LaRC specific deliverablesR2>~~, fabrications, and facility tests~~<R2. R1>The Contractor shall also participate in the ESOD and FPD Project Planning Team responsible for providing expert schedule guidance and support to new projects. The Contractor shall also participate as a trainer teaching the ESOD and FPD WBS & Schedule classes.<R1
2.1.1: Deliverables: R2>Provide ESOD and FPD Core Management personnel with the ESOD and FPD training materials for the WBS & Schedule classes.<R2
2.2: Subtask 2 -- Notice of Clarification (NOC item) Proposal Teams, New Programs, and Projects
The Contractor shall provide planning and scheduling support for the Center's new business proposal development activities and for new program/project start-up activities. Since this work emerges throughout the year, the Contractor shall plan to support approximately four new proposal efforts per year and two new start efforts per year which shall require, as a minimum, development of an integrated master schedule and Work Breakdown Structure for the project and expert advice to proposal development teams.
2.2.1: Deliverables: Master Schedule and Work Breakdown Structure

2.3: Subtask 3 -- Constellation Program (Cx): An IMS will be developed for the Cx Systems Engineering & Integration (SE&I), Test and Verification and Advanced Projects Office (APO).
2.3.1: Deliverables: Cx Integrated Master Schedule (IMS) Gantt Chart

2.4: Subtask 4 -- Orion (formerly Crew Exploration Vehicle (CEV)
2.4.1: LaRC Orion Project Office
2.4.1.2: Deliverables: Orion Integrated Master R1Monthly Report (MMR), Orion Master Schedule for various presentations (as required)

Detailed schedules will be developed and managed for the following Orion elements:

2.4.2: Thermal Protection System
2.4.2.1: Deliverables: Updated Integrated Master Schedule (IMS) posted on Windchill (monthly), Langley Center Management Council (CMC) schedule charts (monthly), Ames Program Management Council

(APMC) schedule charts (monthly), Orion Crew Module Technical, Cost, Schedule and Risk (TCSR) schedule charts (quarterly), Langley MMR (monthly, pending IMS baseline), Master Schedule for various reviews and presentations (as required)

2.4.3: Landing System
2.4.3.1: Deliverables: Updated Integrated Master Schedule (IMS) posted on Windchill (monthly), Langley Center Management Council (CMC) schedule charts (monthly), Orion Crew Module Technical, Cost, Schedule and Risk (TCSR) schedule charts (quarterly), MMR (monthly, pending IMS baseline), Master Schedule for various reviews and presentations (as required)

2.4.4: Orion Aerosciences Project
2.4.4.1: Deliverables: Langley schedule status for IMS (JSC – led) (monthly), Schedule charts for various reviews and presentations (as required)

2.4.5: Flight Test Article
2.4.5.1: Deliverables: Updated Integrated Master Schedule (IMS) (monthly), Langley Center Management Council (CMC) schedule charts (monthly), MMR (monthly, pending IMS baseline), Master Schedule for various reviews and presentations (as required), Langley schedule status reported to Flight Test Office (frequency TBD)

Begin R2 block addition
2.4.6: Relative Navigation Sensors (DTO)
2.4.6.1: Deliverables: Updated Integrated Master Schedule (IMS) (monthly), Langley Center Management Council (CMC) schedule charts (monthly), MMR (monthly, pending IMS baseline), Master Schedule for various reviews and presentations (as required), Langley schedule status reported to Orion Project Office (frequency TBD).
End R2 block addition

2.5: Subtask 5 -- Ares I (formerly Crew Launch Vehicle (CLV))
Project planning and schedule management shall be provided to the Ares (formerly Crew Launch Vehicle) Project Office at Langley Research Center (LaRC).
2.5.1: Deliverables: An integrated master schedule (IMS) of the work LaRC is responsible for shall be maintained for the project office and for inputs into the Marshall Space Flight Center (MSFC) program IMS. 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). Future deliverables may include charts for the Center Management Center (CMC) reports, if and when Ares I becomes part of that review.

Begin R1 block update
2.5.2: CMLAS R2>(Renumbered below as 2.6.2)

2.6: Subtask 6 -- Ares I-*X*: The Contractor shall provide project planning and schedule management to the Ares I-X project. The mission of Ares I-X is to develop a flight test vehicle to gain technical insight and provide early risk reduction for the Ares project. The project is divided into Elements that are supported by several NASA Centers and contracting companies. Schedule development and maintenance shall include coordinating with all Element and Task managers from LaRC and other NASA centers as appropriate. The

schedule shall be maintained and updated based on these multiple coordination activities. For EVM purposes, Primavera is the required tool for the Integrated Master Schedule.
End R1 block update

2.6.1: Deliverables: 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). Other deliverables shall include Center Management Center (CMC) reports, custom filtered reports for LaRC Elements (for example, Integrated Design; Fabrication & Assembly; Integration and Testing; and Launch Operations.), and Earned Value Management reports when the EVM modules in Primavera are available.

2.6.2: CMLAS R2>(Renumbered from 2.5.2 above)
2.6.2.1: **Deliverables**: Updated Integrated Master Schedule (IMS) (monthly), Langley Center Management Council (CMC) schedule charts (monthly), MMR (monthly, pending IMS baseline), and Master Schedule for various reviews and presentations (as required).

2.7: Subtask 7 -- Space & Exploration Research & Technology (SER&T)
2.7.1: Deliverables: Space & Exploration R&T Integrated Master R2>schedule, Gantt chart, MMR, and EVM Analysis Reports from participating projects and Monthly management Report.<R2

Detailed schedules will be developed and managed for the following Space & Exploration Research & Technology (R&T) elements:

Begin R2 block update
2.7.2: SER&T Technology Integration
2.7.2.1: Deliverables: Requires obtaining project(s) milestones and schedule status each month for the SER&T projects.

2.7.3: Radiation Human Health Technologies
2.7.3.1: Deliverables: Requires obtaining project(s) milestones and schedule status

2.7.4: Aerospace Structures and Materials Systems
2.7.4.1: Lightweight Structures and Mechanisms Project- Requires obtaining schedule status from supporting centers (JPL, JSC, and LaRC).
2.7.4.1.1: Deliverables: ETDPO Integrated Master Schedule, detail schedules and phasing reports, and EVM Analysis Report.
2.7.4.2: Advance Composites Project- Requires obtaining schedule status from supporting centers
2.7.4.2.1: Deliverables: ETDPO Integrated Master Schedule, detail schedules and phasing reports, EVM Analysis Report, Baseline Reviews.

2.7.5: Supportability Project and Operations
2.7.5.1 – Supportability Project: Requires obtaining schedule status from supporting centers (GRC, JSC, MSFC, KSC and LaRC)
2.7.5.1.1: **Deliverables** to ETDPO Integrated Master Schedule, EVM Analysis Report, Schedule Risk Mitigation Chart.

2.7.6: Flight Systems for Aeroassist, Entry, Descent, and Landing