Marshall Space Flight Center
Engineering, Science & Technical Services

Task Order Plan (TOP)

Contract Number: *NNM05AB50C*
TO Title: *Lightweight Materials and Structures - Risk Mitigation*
TO Number: *34-020001* **Revision:** *13*

Period of Performance: *10/02/2010* to *07/29/2011*

MSFC Initiator: *John Vickers*

(b)(4)

Emergency: *No*

REVISION 13:
The purpose of this revision is to extend this task into Contract Year 6 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period October 2, 2010 through July 29, 2011. The Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance. Discussion of revisions prior to this revision was moved to Appendix A.

1.0 Task Order Description & Objectives

Specific projects to be supported are listed in separate subelements below:

Subelement 01 – Space Systems Development and Integration
Jacobs ESTS Group shall provide discipline level support in the areas of materials and processes, manufacturing, research and technology development; engineering analysis, laboratory/field /flight experiments; materials test and failure analysis; engineering audits, studies, and resolution of technical problems. Provide recommendations on policy and procedures for damage tolerance practices for space flight hardware.

Provide support to assist the MSFC to evaluate programs and projects technical decisions and rationale, and provide insight into high-risk activities. Provide counsel on technical aspects and strategy for research and development capability for accomplishing engineering functions associated with the design, development, testing, operations, and evaluation of assigned projects and future missions.

Provide independent analysis of Engineering Directorate organizations including the Chief Engineers Office to ensure that all engineering activities are accomplished within the technical requirements and are integrated with program/project cost and schedule constraints. Provide assessment of communicating, implementing, and executing technical excellence across engineering and throughout MSFC. Provide in-depth technical support to ensure technical adequacy of engineering products, and appropriate interrelation of engineering activities. Provide independent analysis of planning and results of engineering research and technology projects after completion.

Provide mentoring, technology transfer, engineering knowledge capture, and lessons learned.

Provide support for recommendations concerning the requirements at all major design reviews including Preliminary Design Review (PDR), Critical Design Review (CDR), Design Certification Review (DCR), and pre-Flight Readiness Reviews.

Advanced Composites Technology Support

Identify and develop composite materials and manufacturing processes for infusion into Ares V structural design and manufacturing flow. These material and processes will be selected based on their maturity and their potential to meet the challenges of successfully scaling up to large structures required for Ares V. Accomplishing this objective will yield lighter weight, more efficient, and more robust single-piece structures that may be used for current and future launch vehicles. The materials and manufacturing element is organized into specific sections to identify material system and processes that need to be matured or are ready for infusion into the Ares V design. The tasks are Material Selection, Manufacturing Process, Materials and Process Testing, and Process NDE and Structural Health Monitoring. Technology tasks will be executed within these areas to develop material systems and processes for Ares V structures.

Subelement 02 – Intelligent and Integrated Manufacturing/Supply Chain Integration

- Identify and evaluate tools and techniques for integrated PLM and end-to-end enterprise supply chain design and planning.
- Develop a set of recommended tools and techniques for integrated PLM and end-to-end enterprise supply chain design and planning.
- Develop an implementation plan for PLM.
- Support the Intelligent and Integrated Manufacturing Systems (IIMS) forum.
- Conduct supply and demand market assessments for high performance composites.
- Provide Product Lifecycle Management (PLM) and Product Data Management (PDM) support to the Engineering Directorate (ED) at MSFC.
- Modify PrimeSupplier software to make it more robust and easier to use by NASA and DoD in supporting development and monitoring of stable and high performing supply chains.

Subelement 03 – Nondestructive Evaluation (NDE) Special Test Equipment (STE) (Closed)

Ares I Project, Upper Stage (US) Element will have a need for high resolution portable Non- NDE tools to accommodate in process inspections and test, non-conformance investigation, and performance optimization of the space vehicle.

This effort will define and develop additional Special Test Equipment (STE) NDE technology capabilities to support Upper Stage at the various location and in its various configurations. The value of such a capability would be realized with the ability to perform high resolution inspections on the US vehicle in its various configurations or locations in order to prevent the need for returning to the factory or the need to disassemble the vehicle.

Subelement 04 – Plume Diagnostics

This effort will produce, check out, demonstrate, and deliver a low-cost, portable propulsion testbed to be used for the development and qualification cost of materials and sensors. While directly applicable to the Ares Project, the proposed capability is fully applicable to the needs of other launch system and space components.

Subelement 05 – High Temperature NDE STE

This effort will build from the existing portable, handheld and user friendly emissivity cameras and perform advanced development and demonstration of a high temperature (500-800°F) Sensor for Materials, Structures and propulsion element NDE which could be utilized on Ares and J-2X nozzle coatings, composite structures, foam insulation and other materials and health monitoring applications.

Subelement CA – Ares I Upper Stage Integrated Manufacturing and Assembly (WBS:136905.08.05.12.01.08) (Administratively closed prior to Rev 12)

Provide a manufacturing execution system testbed for evaluation.

2.0 Technical Approach (Including required input, guidelines & assumptions)

Historical discussion of technical approach prior to revision 13 was moved to Appendix B.

Subelement 01 – Space Systems Development and Integration

Advanced Composites Technology Support

- Select materials for fabrication of various Constellation vehicle component design concepts based upon manufacturing methods, availability of materials allowable properties, and environmental durability.
- Select a mature fabrication approach and develop a manufacturing plan through the construction of large composite test elements that are representative of Ares V structures.
- Define an experimental data test matrix that will: (a) fill in gaps in existing databases that exist due to the Ares V operating environment; and (b) increase confidence that the selected manufacturing processes will result in structures that meet the desired performance levels.
- Prepare a suite of nondestructive evaluation (NDE) and structural health monitoring (SHM) techniques to identify and evaluate any defects or damage identified during the life cycle of a hardware application.

Subelement 02 – Intelligent and Integrated Manufacturing/Supply Chain Integration

White Paper on Model Based Enterprise

Provide support to the National Center for Advanced Manufacturing at the NASA Marshall Space Flight Center by preparing a report on the role in advanced manufacturing of model-ready supply networks functioning in a globally collaborative environment. This report will summarize and expand upon the outcomes of the recently held workshop on Integrated and Intelligent Manufacturing Systems & the Model Based Enterprise (Task 10). This workshop was jointly sponsored by DoD and NASA and was held in New Orleans in June, 2010.

PrimeSupplier Software Modification support

- The architecture of the model will be reviewed in terms of the company module, the programmatic module, the financial module and the structure of input data. Assessments will be made of the structure in terms of adding additional features to PrimeSupplier such as importation of data, supply chain readiness metrics and hierarchical interrelatedness among companies in the supply chain.
- The calculation of risk using programmatic demand data and financial data will be reviewed and assessed for completeness. The addition of additional data in these calculations, such as the debt to equity ratio, will be developed.
- The availability of downloadable real time data for import into the PrimeSupplier software will be determined. For privately held companies, alternative sources of data will be identified. Access to programmatic data and the structure of that data for import will be evaluated.
- The output of PrimeSupplier will be incorporated into metrics to assess the financial sustainability component of supply chain readiness level. Furthermore, an assessment will be developed to evaluate the supply chain readiness that will utilize the financial stability metrics, as well

as other readiness components, such as risk management, collaboration, criticality focus, life-cycle awareness and utilization of modeling and simulation.

- The recommended modifications to PrimeSupplier to accommodate the automatic importation of data will be implemented with Government approval.
- The new PrimeSupplier software model will be applied to a particular program and supply chain of interest. The program and supply chain to be addressed will be approved by the Government before implemented within the model. Programmatic, financial and supply chain readiness level data will be developed and loaded into the software. A demonstration of the model will be conducted and risk points identified.
- Based upon the prior tasks, recommendations will be developed for the modification of PrimeSupplier software. These recommendations will address model structure, algorithms, and formats for model output.
- A final report will be prepared that describes the new PrimeSupplier software and its application to the Proof of Concept program.

Subelement 04 – Plume Diagnostics

- Deliver a portable propulsion test bed for the characterization and testing of high performance materials and sensors for Ares vehicle applications and other NASA systems.
- Develop the system engineering requirements for the test bed according to specific, customer-defined applications and will document, configure, and control these requirements via a Systems Requirements Document (SRD).
- Acquire/procure all parts and components for the test bed based on performance (form, fit and function), cost, schedule, complexity, and availability.
- Integrate and construct a propulsion test bed that meets the physical requirements in the SRD. Operate the test bed to verify performance to the functional requirements.
- Conduct operational testing by integrating with a selected sensor. Remote diagnostics and monitoring will be used to characterize the test bed plume.

Subelement 05 – High Temperature NDE STE

- Assist in the development of preliminary general system engineering requirements for the sensor and testbed capability tailored for specific, customer defined applications. Document, configure and control these requirements via a Systems Requirements Document (SRD).
- Redesign, as required, the two Phase I cameras to accommodate the J-2X nozzle requirements. Specifically, one camera will be optimized for external nozzle surfaces, configurations and operations and the other for the internal nozzle surfaces, configurations and operations.
- Update, configure and release the design and maintain configuration for as-built/as-designed compliance.
- Acquire the necessary parts, integrate and complete assembly of the two units. Each unit will be optimized for the unique optical requirements of the J-2X internal and external surfaces. The units shall be updated with software modifications, as required to checkout and complete the units for testing. Configuration control of the two units will be maintained. The prototype units will be suitable for system-level experimentation, field testing, and non destructive evaluation applications.
- Prepare a test plan outlining all testing activities. Both operational and environmental testing/evaluation will be conducted or equivalent analysis submitted. Operational testing will include verification of performance and functional requirements, design qualification, and user evaluation. The test plan will provide clear test objectives for STE characterization for J-2X internal and external nozzle assessments. The test plan will also accommodate for any required field testing. Characterization of the unit will be performed with remote diagnostics and monitoring of available test articles.
- Test the prototype units according to the test plan and iterate, improve and characterize prototype performance for the J-2X internal and external nozzle requirements. Graphic user inter-

face, software modifications, optical performance, firmware and electronic performance are likely to be performed during the characterization activities.

- Prepare and deliver a test report that describes the characterized performance and operation of the prototype units, highlighting differences and similarities in the two applications.

3.0 Discussion of Skills Required

Subelement 01:
Associated experience with integration of composite materials into designs, analyses and manufacturing for space components, particularly CLV applications is required.

Subelement 02:
ESTS Group shall provide at least (b)(4) (b)(4) Experience in supply chain design and optimization, product life cycle management and risk management is also required. (b)(4) (b)(4) (b)(4)

Subelement 04:
This effort will require support from (b)(4) (b)(4) (b)(4)

Subelement 05:
This effort will require at least (b)(4) (b)(4)

4.0 Special Tools Required

Computer workstations capable of performing finite element analysis and other process intensive applications are needed to support subelement 01.

5.0 Participating Subcontractors

(b)(4)

6.0 Milestones & Deliverables

Deliverables will include: monthly activity reports, final reports, technical papers, technical presentations, systems requirement documents, test plans, special test equipment (STE), test panels, meeting minutes, trip reports, lists of recommended tools, a PLM implementation plan, forum documentation, NDE special test equipment, high-temperature NDE special test equipment, propulsion testbed, and verbal responses to customer requests.

7.0 Special Considerations (Recruiting, Special Equipment / Material, Safety, etc.)

None

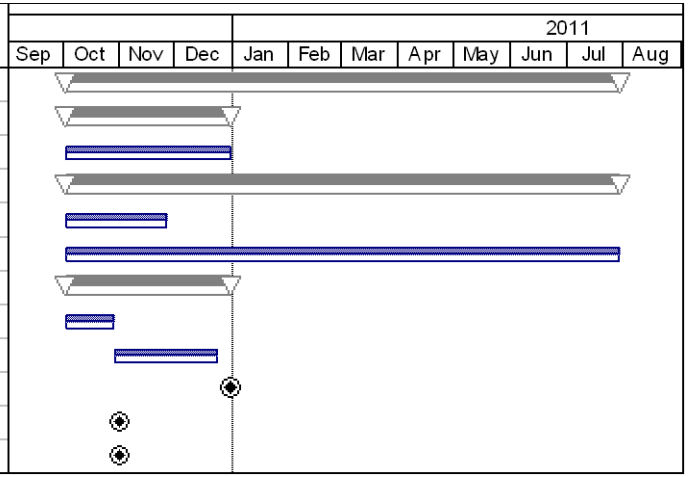
8.0 Work Shelf

The following activities could be accomplished as part of the Task Order performance by personnel that are temporarily available due to program or funding delays on other Tasks. Specific assignments will be coordinated with the Task Initiator to ensure appropriate skills and experience.

TO/Subelement	Description	Due Date	Skill

9.0 Schedule

Task Order #	Subelement	Task Work Element
34-020001	**00**	**Lightweight Materials and Structures - Risk Mitigation**
34-020001	**01**	**Space systems development and integration**
34-020001	01	Advanced Composites Technology Composites Support
34-020001	**02**	**Intelligent and Integrated Manufacturing/Supply Chain Integration**
34-020001	02	White Paper on Model Based Enterprise
34-020001	02	Further Develop PrimeSupplier Software
34-020001	**04**	**Plume Diagnostics**
34-020001	04	Develop Test Plans
34-020001	04	Perform Testing
34-020001	04	Deliver Propulsion Test Bed
34-020001	**05**	**High Temperature NDE STE**
34-020001	05	Deliver NDE STE



Appendix A
History of Revisions Prior to Revision 13

REVISION 12:
The purpose of this revision is to adjust estimates to reflect changes in scope for the remainder of the year. Specific details on the changes to each subelement are provided below. The total task order estimate decreased by (b)(4) The Performance Plan and Schedule were revised to reflect the changes in scope. The Risk Assessment was not been revised since it was not impacted by the changes reflected in this revision.

- The subcontractor estimate for subelement 01 was decreased to reflect a reduction in scope for Advanced Composites Technology (ACT) support this year.
- The estimate for subelement 02 was decreased to reflect a reduced scope to further develop the PrimeSupplier software model this year. This effort has been pushed into next year due to a delay in obtaining funding.
- The subcontract estimate for subelement 04 was decreased due to part of this effort shifting to next fiscal year. Travel estimate was deleted since it is not required this year.
- The subcontract estimate for subelement 05 was decreased due to part of this effort shifting to next fiscal year. Travel estimate was deleted since it is not required this year.
- Subelement CA was administratively closed as part of the Ares replanning effort and this revision documents this closure.

REVISION 11:
The purpose of this revision is to adjust estimates to reflect changes in scope as directed by the Task Initiator. Specific details on the changes to each subelement are provided below. The total task order estimate increased by (b)(4) The Performance Plan and Schedule were revised to reflect the changes in scope. The Risk Assessment was not been revised since it was not impacted by the changes reflected in this revision.

- The estimate for subelement 01 was increased to reflect additional scope to extend the Advanced Composites Technology (ACT) support through the end of the period of performance.
- The estimate for subelement 02 was increased to reflect additional scope to further develop the PrimeSupplier software model developed by KSC for addressing supply chain economic stability. This effort will make the software more robust and easier to use by NASA and DoD in supporting development and monitoring of stable and high performing supply chains.
- The labor estimate for subelement 04 was revised to reduce administrative effort and slightly increase engineering effort to provide more engineering oversight and review in support of the subcontractor's efforts to develop a propulsion testbed. This was a no cost change.
- The scope of subelement 05 was revised to reflect a change in customer requirements from developing new high temperature NDE STE to modifying the NDE STE developed under subelement 03 to support evaluation of J2X nozzles and characterize the performance of the STE. The estimate, was revised to reduce administrative effort and slightly increase engineering effort to provide more engineering oversight and review. This resulted in a negligible cost reduction.
- Subelement CA (WBS:136905.08.05.12.01.08) was added to support the procurement of a manufacturing execution system testbed for evaluation at MSFC.

REVISION 10:

The purpose of this revision is to extend this task into Contract Year 5 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period October 3, 2009 through October 14, 2010. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

- Subelement 04 was added to support the development of a Propulsion Testbed with a subcontract to Orion Propulsion.
- Subelement 05 was added to support the development of high temperature nondestructive evaluation special test equipment with a subcontract to (b)(4) (b)(4)

REVISION 09:

The purpose of this revision is to more accurately reflect the effort required during this period of performance. Specific details on the changes to each subelement are provided below. The total task order estimate is decreased from (b)(4) a decrease of (b)(4) The Performance Plan, Schedule and Risk Assessment have not been revised since they are not impacted by the changes reflected in this revision.

Subelement 01 – Space Systems Development and Integration (Revised):

Labor:

This revision reduces the engineering management estimate (b)(4) but adds administrative support estimate (b)(4) The overall impact of this change is an increase of (b) labor hours, but a decrease of (b)(4)

Materials:

This revision removes (b)(4) in materials estimate because the manufacturing execution software trials originally estimated here will be billed as other direct charges (ODC) and not all the effort will be invoiced this fiscal year.

Other:

This revision adds (b)(4) in ODC to cover the manufacturing execution software trials. Approximately (b)(4) of this effort will continue into next year and will be estimated on the task order revision that continues this work into the next contract year, CY5.

Subcontract:

This revision decreases the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support from (b)(4) that will be invoiced this year.

Subelement 02 – Intelligent and Integrated Manufacturing/Supply Chain Integration (Revised):

Labor:

This revision reduces the engineering management estimate (b)(4) but adds administrative support estimate (b)(4) The overall impact of this change is an increase of (b) labor hour, but a decrease of (b)(4)

Subcontract:

This revision decreases the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support. Estimate for (b)(4) to Provide Product Lifecycle Management (PLM) and Product Data Management (PDM) support to the Engineering Directorate (ED) at MSFC was reduced by (b)(4) because this effort is expected to be invoiced next contract year. Estimate to support (b)(4) was decreased by (b)(4) because this

effort is expected to be worked next contract year. Estimate for (b)(4) was increased by $(b)(4) to reflect the additional support required from (b)(4) The effort for (b)(4) and (b)(4) expected to carry over to next year will be estimated on the task order revision that continues this work into the next contract year, CY5.

Subelement 03 – Nondestructive Evaluation (NDE) Special Test Equipment (STE) (Revised):

Labor:

This revision reduces the engineering management estimate ((b)(4), but adds administrative support estimate (b)(4) The overall impact of this change is an increase of (b) labor hours, but a decrease of (b)(4)

REVISION 08:

The purpose of this revision is to more accurately reflect the effort required during this period of performance. Specific details on the changes to each subelement are provided below. The total task order estimate is increased from (b)(4) an increase of (b)(4). The Performance Plan, Schedule and Risk Assessment have not been revised since they are not impacted by the changes reflected in this revision.

Subelement 01 – Space Systems Development and Integration (Revised):

Materials:

This revision adds (b)(4) in materials estimate to cover manufacturing execution software trials.

Subcontract:

This revision increases the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support from (b)(4) It includes support for additional scope to identify and develop composite materials and manufacturing processes for infusion into Ares V structural design and manufacturing flow.

Subelement 02 – Intelligent and Integrated Manufacturing/Supply Chain Integration (Revised):

Subcontract:

This revision increases the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support. (b)(4) was added to support an increase in scope for (b)(4) (b)(4) to Provide Product Lifecycle Management (PLM) and Product Data Management (PDM) support to the Engineering Directorate (ED) at MSFC. Estimate to support (b)(4) was decreased by (b)(4 to reflect (b)(4) actual contract value. Estimate for (b)(4) was increase by (b)(4) to reflect the additional support required from (b)(4)

Subelement 03 – Nondestructive Evaluation (NDE) Special Test Equipment (STE) (Revised):

Subcontract:

This revision increases the subcontracting estimate by (b)(4) to more accurately reflect the payment schedule for the NDE equipment being developed by (b)(4) This does not increase the total required funding, but moves expenses originally planned for next year to this year.

REVISION 07:

The purpose of this revision is to extend this task into Contract Year 4 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period September 27, 2008 through October 2, 2009. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

REVISION 06:

The purpose of this revision is to more accurately reflect the effort required during this period of performance. Specific details on the changes to each subelement are provided below. The total task order estimate is decreased from (b)(4) No additional budget is required for any of the subelements. The Performance Plan and Risk Assessment have not been revised since they are not impacted by the changes reflected in this revision.

Subelement 00 – Lightweight Materials and Structures - Risk Mitigation (Revised):

Subcontract:

This revision increases the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support.

Subelement 01 – Space Systems Development and Integration (Revised):

Labor:

This revision increases the labor estimate by (b)(4) hours ((b)(4) to more accurately reflect the effort required during this period of performance.

Subcontract:

This revision reduces the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support from (b)(4)

Subelement 02 – Intelligent and Integrated Manufacturing/Supply Chain Integration (Revised):

Labor:

This revision increases the labor estimate by (b)(4) hours ((b)(4) to more accurately reflect the effort required during this period of performance.

Subcontract:

This revision increases the subcontracting estimate by (b)(4) to more accurately reflect the expected level of subcontract support from (b)(4)

REVISION 05:

The purpose of this revision is to increase the scope of this task to include Intelligent and Integrated Manufacturing/Supply Chain Integration, which is moving from Task 34-010003 subelement 71. The original scope of this task has been assigned to subelement 01 and the new scope has been assigned to subelement 02 in order to facilitate management of these two efforts. Subelement 00 shows costs associated with effort in support of Space Systems Development and Integration prior to this revision.

REVISION 04:

The purpose of this revision is to extend this task into Contract Year 3 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period 29 September 2007 through 26 September 2008. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect any changes in task activities for the new period of performance.

REVISION 03:
The purpose of this revision is to increase the scope of this task to include effort to support NASA programs in the areas of Space Transportation and Propulsion Systems and Space Systems Development and Integration.

REVISION 02:
The purpose of this revision is to:

- Increase the scope of this task to include effort to support an operational readiness review, and other composites material processing activities for the MSFC National Center for Advanced Manufacturing (NCAM).
- Extend the period of performance to September 28, 2007.
- Change the task order lead to Barrie Peters.

REVISION 01:
The purpose of this revision is to:

- Extend this task into Contract Year 2 of the NNM05AB50C ESTS contract. This revision defines and estimates work for the period 30 September 2006 through 29 December 2006. Additionally, the Schedule, Performance Plan and Risk Assessment have been revised to reflect changes in task activities for the new period of performance.

Funding for this revision is provided per MSFC PR 4200173425.

Appendix B
History of Technical Approach Prior to Revision 13

Subelement 01 – Space Systems Development and Integration

- Provide expert technical support in the following areas:
    - materials and processes,
    - manufacturing,
    - research and technology development,
    - engineering analysis,
    - laboratory/field /flight experiments,
    - materials test and failure analysis,
    - engineering audits,
    - resolution of technical problems.
- Recommend policies and procedures related to damage tolerance practices for space flight hardware.
- Evaluate programs and projects technical decisions and rationale, and provide insight into high-risk activities.
- Provide counsel on technical aspects and strategy for research and development capability for accomplishing engineering functions associated with the design, development, testing, operations, and evaluation of assigned projects and future missions.
- Provide independent analysis of Engineering Directorate organizations including the Chief Engineers Office.
- Provide assessment of communicating, implementing, and executing technical excellence across engineering and throughout MSFC.
- Provide in-depth technical support to engineering activities, and the development of engineering products.
- Provide independent analysis of planning and results of engineering research and technology projects after completion.
- Provide mentoring, technology transfer, engineering knowledge capture, and lessons learned.
- Provide support for recommendations concerning the requirements at major design reviews including Preliminary Design Review (PDR).
- Write Technical Memoranda on projects and technology related to flight hardware.

Subelement 02 – Intelligent and Integrated Manufacturing/Supply Chain Integration

Identify and Evaluate Tools and Techniques for Integrated PLM and End-To-End Enterprise Supply Chain Design and Planning

Four areas of focus and study are needed to support the Product Lifecycle Management efforts for the new launch booster and it's components from conceptualization, design, development, use to reuse, and recycle. To accomplish this task, the subcontractor will address the following four areas of concentration for the identification, study and evaluation of tools:

Data Management - this area of PLM includes the acquisition, storage, access control, and retrieval for documents of all stages of the lifecycle. This system will act as the master document library to enable automated Bill of Materials development, automated manufacturing tracking, and overall costing controls. Documents to be managed include all existing NASA initial con-

cept and high level design documents, all CAD / CADAM / CATIA type of documents, all automated three dimensional modeling files, all component and computer aided simulations, and other documents created during the lifecycle of a booster and it's components.

Information Access – this area of PLM includes the ability of NASA and contractor personnel to access relevant information contained within documents of any type within the NASA and contractor electronic systems. This information includes structured textual information, digital images, digital simulations, unstructured textual information, and unstructured audio. Access will need to be security controlled and locally managed by the appropriate NASA and / or contractor staff.

Asset Administration – this area of PLM includes the ability for NASA and contractor personnel to manage the assets developed during the design and manufacturing processes. This includes the ability to maintain all types of information at the asset level. This will enable NASA and contractor personnel to have full knowledge of all components used during the booster pre-launch build including monitoring for engineering version mismatches, environmental exceptions, and other pre-launch build information requirements.

Supply Chain Design and Integration – this area of PLM includes the ability for NASA and contractor personnel to map and visualize multi-tier supply chain maps and identify critical paths over the life cycle. This area also includes the ability to analyze optimum Inventory and network strategies and to define Push-Pull Boundaries within the supply chain. Modeling and simulation techniques and approaches will be included. Tools and techniques for risk pooling and risk sharing within the supply chain and providing adaptability and resilience will also be identified and evaluated.

Develop a Set of Recommended Tools and Techniques for Integrated PLM and End-To-End Enterprise Supply Chain Design and Planning

Interviews at MSFC and Site Assessment at Michoud Assembly Facility - Prior to developing a set of recommendations for PLM tools & technologies, it is important to conduct a preliminary assessment of the application environment and real world issues and processes. This will be accomplished through a set of interviews at MSFC and an overview site assessment at the Michoud Assembly Facility (MAF). This assessment will permit an understanding of current operations and identification of constraints and opportunities for PLM and for extended enterprise supply chain implementation improvements. The assessment will evaluate other projects that share the MAF and suppliers that provide critical hardware to NASA and the aerospace industry.

Recommended Tools and Technologies for Integrated PLM – Based on the evaluations conducted in Task 1, the interviews at MSFC, and Michoud site visit, the subcontractor will develop a set of recommended tools and technologies for achieving integrated PLM of the Aries I program. Provide to MSFC briefings on PLM/Supply Chain critical management and engineering practices for NASA.

Develop an Implementation Plan for PLM

The subcontractor will develop a detailed Enterprise Ares I (CLV) Upper Stage Path Forward (Plan) for NASA's successful implementation of extended enterprise PLM for the Ares program.

This will detail the process of implementing each of the recommended tools and technologies, including a time line for the process.

Findings and the recommended path forward plan that includes an implementation plan to be executed by NASA MSFC personnel with assistance from subcontractor personnel will be presented to NASA MSFC Senior Management for concurrence.

Intelligent and Integrated Manufacturing Systems (IIMS) Forum

ESTS Group will provide the services necessary to plan and execute a successful forum and will report the results of that forum. NASA Marshall Space Flight Center will provide the sponsorship for IIMS Forum III to be conducted in Huntsville, Alabama in March, 2008. Further, Jacobs will update the IIMS master document, consistent with the results of the forum.

Planning and preparation: ESTS Group will work with NASA MSFC to define an IIMS thrust area of particular interest to NASA. For this topic area, Jacobs will:

- Prepare a prospectus that places the thrust area in the context of IIMS
- Recruit participants who can contribute to a rich discussion
- Work with MSFC staff to arrange logistics for the forum

Conduct of the Forum: ESTS Group will serve as the moderator for the forum.

Post Forum Documentation: ESTS Group will deliver to NASA MSFC and will post on the (b)(4) website a rich set of notes from the forum. Specifically, Jacobs will tabulate the findings from the small group sessions and will publish a "technology roadmap" for that thrust area.

Conduct supply and demand market assessments for high performance composites

This effort will provide the status of the composites industry today and forecasts the market for 2008-2020. The perspective will be from that of an aerospace component manufacturer. What factors are influencing the composites market? Focus will be on the thermoset high performance carbon fiber epoxy composites market. This effort will provide trends and forecast for the domestic and global composites industry primarily in aerospace and secondarily in various market segments such as automotive, marine, construction, wind energy, sporting goods and other. The effort may also provide brief top-level analysis of growths in India and China markets.

The effort will address but not be limited to the following questions:

- How big is the composites market; by $ shipment and by Million lbs?
- How big is the market for composites by continents and by country?
- How big are the markets for aerospace, automotive, marine, construction, wind energy, sporting goods, and other?
- What are the market shares and who are the industry leaders in various market segments as well as in raw materials?
- What are the market potentials for composite products in various market segments?
- What are the growth rates and forecasts (2008-2020) in various market segments?
- How big is the market for fiber placement, filament winding, hand lay-up, RTM, compression molding, and other manufacturing processes?

- What are the primary issues related to materials and infrastructure in the market (what are autoclave size limitations and availability)?
- What are the primary issues in the market and the prospects for growth?

Subelement 03 – Nondestructive Evaluation (NDE) Special Test Equipment (STE) (Closed)

ESTS Group will acquire all parts and components in order to prototype the Handheld STE Tool via a make/buy decision process based on several factors (cost, schedule, complexity, etc.).

The Contractor will assist in the integration and construction of two prototype Handheld STE Tool units that are suitable for accessing usability at system-level experimentation, field testing, and non destructive evaluation applications. A Test Plan will be prepared outlining all testing activities. Both operational and environmental testing/evaluation will be conducted or equivalent analysis submitted. Operational testing will include verification of performance and functional requirements, design qualification, and user evaluation.

NDE STE System Requirement Goals

The STE tool will be a lightweight sensor capable of single-man delivery and emplacement, which will be able to operate either wirelessly connected to a distant monitoring station, or under the direct watch and control of a test agent. Either the remote or local application will permit high speed graphic presentation of highly accurate temperature, emissivity, and radiance information. When combined with intelligent pattern detection, the resulting images will be used to augment and support the automated detection of material defects, coating degradation or other material or structural abnormalities.

Environmental and Robustness Requirements

- Operate across full ranges of atmospheric temperature, pressure and humidity.
- Survive and operate as follows:
  - Shipment in cargo bays and commercial transport vehicles
  - Accidental drop from shoulder high level

Electrical Power Requirements

- Standard power capability (i.e. 110 VAC)
- Provide option for autonomous, battery-powered operation over a 1-hour period
- Provide rechargeable/external batteries & charger as an option to standard plug-in power

External Interface Requirements

- Provide for the use of removable media.
- Provide external Ethernet (LAN or Wireless) interface to support communication & software updates
- Provide means of connecting an external battery charger.

Human Interface Requirements

- Provide for intuitive and/or cued operation to minimize training requirements.
- Provide User Interface menus that sequentially prompt user actions and support selection of options and parameters.
- Provide for user entry of numeric data.

Capability Requirements

- Remotely measure temperature, radiance and emissivity of targets
- Wireless and/or LAN networking capability

Physical Characteristics Requirements

- Maximum Size, including external high-density foam cushioning:
  - Length <16” (requirement), <12” (goal)
  - Width: <14” (requirement), <12” (goal)
  - Height: < 8 “ (requirement), < 6” (goal)
- Maximum Mass: <15.0 lbs (requirement), <12.0 lbs (goal)

Software Requirements

- Software shall provide for viewing and instant analysis of remotely captured images & video.

Subelement CA – Ares I Upper Stage Integrated Manufacturing and Assembly (Administratively closed prior to Rev 12)

Procure a manufacturing execution system testbed for evaluation at MSFC.

ESTS Contract Task Order Request Performance Plan

Task Order Title: Lightweight Materials and Structures - Risk Mitigation

Task Order Number: 34-020001 Revision: 13

Category	Weighting Technical %	End of Period Technical Score
Technical Objectives	45%	X 45% =
		Justification
The Jacobs ESTS Group shall provide expert materials and manufacturing technical support. Identify and evaluate tools and techniques for integrated PLM and end-to-end enterprise supply chain design and planning then develop a set of recommended tools and techniques for integrated PLM and end-to-end enter-prise supply chain design and planning Build from the existing portable, handheld and user friendly emissivity cameras and perform advanced development and demonstration of a high temperature (500-800„aF) Sensor for Materials, Structures and propulsion element NDE which could be utilized on Ares and J-2X nozzle coatings, composite structures, foam insulation and other materials and health monitoring applications. Produce, check out, demonstrate, and deliver a low-cost, portable propulsion testbed to be used for the development and qualification cost of materials and sensors. While directly applicable to the Ares Project, the proposed capability is fully applicable to the needs of other launch system and space components.		
	Weighting Schedule %	**Schedule Score**
Schedule Objectives (Milestones)	10% *(min 10%)*	X 10% =
		Justification

ESTS Contract Task Order Request Performance Plan

Task Order Title: Lightweight Materials and Structures - Risk Mitigation

Task Order Number: 34-020001 Revision: 13

Submission of Monthly activity reports; Submission of documented results and STE in accordance with project requirements.		
Cost (actual vs. negotiated)	**Weighting Cost%** 45% *(min.25%)*	**Cost Score** X 45% =
		Justification
	Weighting Total % 100.00%	**Total Score**

Technical, Schedule, and Cost Grading Scale

Score	Description
9.0-10.0	Exceeded TO Performance Plan objectives resulting in major benefit(s)
8.0-8.9	Exceeded TO Performance Plan objectives resulting in modest benefit(s)
7.0-7.9	Met TO Performance Plan objectives
3.0-6.9	Did not meet all TO Performance Plan objectives resulting in minimal impact or requiring additional agency funds
0.0-2.9	Did not meet TO Performance Plan objectives resulting in substantial impact and/or requiring additional agency funds

ESTS Contract Task Order Request Performance Plan

Task Order Number: Lightweight Materials and Structures - Risk Mitigation

Task Order Number: 34-020001 Revision: 13

Comments:

Marshall Space Flight Center
Engineering, Science & Technical Services

JACOBS
ESTS Group

Risk Assessment

Contract Number: *NNM05AB50C*
TO Title: *Lightweight Materials and Structures - Risk Mitigation*
TO Number: *34-020001* **Revision:** *13*

Period of Performance: *10/02/2010* to *07/29/2011*

MSFC Initiator: *John Vickers*

(b)(4)

Task Order Risk Assessment to Cost, Technical, and Schedule

List identified risk associated with Task Order performance as related to task cost, technical, and schedule. Classify the risk(s) according to probability of occurrence and impact as defined below and enter the risk into risk matrix.

Risk	Risk Type	Probability (1-4)	Impact (1-4)	Risk Description
Risk C1	Cost	1	2	Subcontractor over charge may result in cost increases
Risk T1	Technical	1	2	Inadequate review of documentation
Risk T2	Technical	1	2	Subcontractor unable to produce the desired STE.
Risk S1	Schedule	2	1	Subcontractor doesn't meet scheduled delivery dates.

*Note: See page 2 for risk mitigation plan for those risks which are Primary Risk Drivers.

Task Order Risk Matrix

		1 Minimal Impact	2 Minor Impact	3 Medium Impact	4 Major Impact
Inevitable Occurrence (>95% Probability)	4	Y	Y	R	R
High Probability of Occurrence (>60% but <95% Probability)	3	G	Y	Y	R
Medium Probability of Occurrence (>25% but <60% Probability)	2	G	Y	Y	Y
Low Probability of Occurrence (<25% Probability)	1	G	G	Y	Y

Legend

- R — **Primary Risk Driver:** Requires Risk Mitigation Plan
- Y — **Caution:** Requires status updates and general plan for risk reduction as determined necessary by Team Lead and Initiator
- G — **Watch:** No Action required

Impact Level	Cost Impact Definition	Technical Impact Definition	Schedule Impact Definition
(1) Minimal Impact	No significant cost impact	No significant technical impact	No significant schedule impact
(2) Minor Impact	Potential to recover cost	Potential to gain required technology without impact	Minor delay in deliverables but no impact to customer
(3) Medium Impact	>0 but <10% subtask cost overrun	Some technical impact but potential to recover	Delay in subtask deliverables but work arounds available and acceptable to customer
(4) Major Impact	>10% subtask cost overrun	Unable to meet technical requirements to perform subtask	Delay in subtask deliverables with impact to customer

Risk Mitigation Plan

Complete the following chart for those risks identified on page 1 as “Primary Risk Drivers”. The following chart will serve as the Risk Mitigation Plan.

Risk No.: Risk Description:		
Mitigation Step No.	Planned Completion Date	Mitigation Step Description
C1	Monthly	Track costs vs. percent technical completion