ATTACHMENT J-1

Statement of Work
For
Specialized Engineering Services for Spacecraft and Launch Vehicle Systems Integration, Design and Analysis

1.0 Scope

The Contractor shall provide systems engineering support to the Marshall Space Flight Center (MSFC) Engineering Directorate, including, but not limited to the Stage Systems Engineering and Integration Division. The Contractor shall provide support for, but not limited to, the development of spacecraft and launch vehicle systems engineering products.

The Contractor shall provide specialized systems engineering services and expertise to all spacecraft and vehicle elements; sub-elements including, but not limited to, integrated systems and subsystems technical hardware and software design, test and evaluation; vehicle and subsystems development and analyses; systems engineering and integration; identifying vehicle hardware and software system and integration issues; sustaining engineering; systems engineering tools; and coordination /support to the technical review process for all elements.

The Contractor shall participate, as directed, in various Technical Working Group (TWG) meetings, interface with the System Integration Groups (SIGs), and participate in monthly reviews and / or telecons to collect the required information for supporting these task processes.

2.0 Task Order Management and Reporting

A. Contractor Management

The Contractor shall provide the planning, coordination, technical direction, and surveillance of the activities necessary to assure disciplined performance of work and timely application of resources for the accomplishment of all tasks issued under the order. The Contractor shall be responsible for maintaining communication with each supported organization and alerting the Contracting Specialist immediately of any problems that would prevent meeting established milestones.

B. Data Deliverables

The contractor shall report and document this work and fulfill the requirements of associated Data Requirement Descriptions (DRD's) as outlined in Data Procurement Document (DPD) 1175 (Attachment J-2). The Contractor shall determine the data restriction that applies to each data deliverable and mark or transmit the data restriction in accordance with section 2.3.3 of the Data Procurement Document.

1. The Contractor shall submit a Monthly Status Report in accordance with DRD 1175MA-003. Any presentation, reports, analyses or technical memorandum that is developed during the execution shall be pre-coordinated with the Task Order Monitor and final copies provided to the Task Order Monitor.

   The Contractor shall provide NASA with necessary information on project progress to allow the Government to monitor product assurance, identify significant problems, and implement corrective action as applicable based on the Contractor's performance.

   The Contractor shall develop and maintain a Work Breakdown Structure (WBS) defining all task elements contained in this Task Order and in accordance with established GSA rates per hours worked.

2. The Contractor shall submit a Badged Employee and Remote IT User Listing in accordance with DRD 1175MA-001.

3. The Contractor shall submit a Contractor Employee Clearance Document in accordance with DRD 1175MA-002.

4. The Contractor shall submit a Position Risk Designation for Non-NASA Employee in accordance with DRD 1175MA-004.

5. The contractor shall submit a Contractor Information Technology Security Program Plan (CITSPP) that documents how the contractor will be responsible for information and IT security in accordance with DRD 1175CD-001.

6. The contractor shall establish and implement an industrial safety, occupational health, and environmental program that (1) prevent employee fatalities, (2) reduce the number of incidents, (3) reduce the severity of employee injuries and illnesses, and (4) protects the environment through the ongoing planning, implementation, integration and management control of these programs in accordance with DRD 1175SA-001. The SHE Plan shall address each of the following MSFC SHE core program requirements in detail that are applicable to the contracted effort:

   a. Management leadership and employee involvement.
   b. System and worksite analysis.
   c. Hazard prevention and control.
   d. Safety, health and environmental training.
   e. Environmental compliance.

7. The contractor shall report mishaps and safety statistics to the MSFC Industrial Safety Office in accordance with DRD 1175SA-002. The contractor shall submit direct to the NASA Incident Reporting Information System (IRIS) or shall use the forms listed in section 15.4 of DRD 1175SA-002 or electronic equivalent to report mishaps and related information required to produce the safety metrics.

3.0 Technical Requirements

The contractor shall be responsible for information and information technology (IT) security when physical or electronic access to NASA's computer systems, networks, or IT infrastructure is required or when NASA information is stored, processed, generated or exchanged with NASA or on behalf of NASA, regardless of where the information resides.

The contractor shall support and implement the information technology security requirements of the NPR 2810.1, Security of Information Technology, when providing services that support the design, acquisition, development, implementation, operations and maintenance of systems engineering tools and other information technology.

All data files and reports electronically delivered shall comply with Technical Standard 1194.21 of the Rehabilitation Act of 1973, Section 508.

Tasks shall be defined as follows:

3.1 Specialized Systems - Engineering and Integration Support for Ares-1 First Stage (FS) and Ares 1-X First Stage

The contractor shall provide specialized system engineering and integration services to the Systems Engineering and Integration (SE&I) functions for the Integrated First Stage including, but not limited to, FSIWG (First Stage Integration Working Group) participation/coordination; Systems Engineering Management Plan (SEMP) implementation; Design and Construction Standards; Specifications and Requirements including Heritage, Interface Requirements Documents (IRDs), Verification, Control Plans, CM/DM (Configuration Management/Data Management), Interface Control Documents (ICDs), Flight and Ground Hazards, FMEAs (Failure Modes & Effects Analysis), Risk, Systems Simulation, Trades and Analysis, Operational Concepts, OMRSDs (Operations and Maintenance Requirements and Specifications Document), and OMIs (Operation and Maintenance Instructions).

The contractor shall provide support for any of the following sub-tasks:

3.1.a. Ares-1 First Stage Support

1) Provide systems engineering support to the MSFC Integration Lead and MSFC Lead Systems Engineering functions in the support of delivery of an integrated First Stage to the FS Project Office. Functions include support to the MSFC Integration Lead and MSFC Lead Systems Engineer in accomplishing the technical oversight of each subsystem, schedule management across engineering disciplines in support of the integration effort, management/oversight of technical trades in support of the

integrated First Stage, technical interface between the Project Office, the Engineering Directorate and other Ares Elements.

2) Provide systems engineering support to develop, document, and maintain the FS element requirements in applicable FS documentation.

3) Provide support to continue the development and / or tailoring and maintenance of the FS DRDs.

4) Support to First Stage SE&I Lead by maintaining SEMP for the FS.

5) Provide support for the DAWG weekly session and action item representation. Support other Technical Working Groups and panels to support system design, analysis, and integration for the FS.

6) Provide support to FS Trade Studies.

7) Provide specific system integration engineering functions in the support of FS. Functions include support to system and element level trade studies, assessment of interfaces and between subsystems, assessment of top level related requirements and verification planning, and schedule/cost inputs. This function will provide the planning, leadership and integration of the system analysis and design activities across the Ares
First Stage in lieu of a formal Integrated Product Team (IPT) and be responsible for maintaining knowledge or documentation of the status of the analysis and design of all the elements and insuring this information is communicated across the element. This function will support the various element leads and ensure communication amongst the engineering discipline working Ares FS as well as interfaces to those supporting US and Ground Operations.

3.1.b. Ares-I 1-X First Stage Support - Closed December 2009

8) Provide systems engineering support to the MSFC Integration Lead and MSFC Lead Systems Engineering functions in the support of delivery of an integrated Ares 1-X First Stage to the FS Project Office. Functions include support to the MSFC Integration Lead and MSFC Lead Systems Engineer in accomplishing the technical oversight of each subsystem, schedule management across engineering disciplines in support of the integration effort, management/oversight of technical trades in support of the integrated First Stage, technical interface between the Project Office, the Engineering Directorate and other Ares Elements.

9) Provide systems engineering support to develop, document, and maintain the Ares 1-X FS element requirements in applicable Ares 1-X FS documentation.

10) Provide support to continue the development and / or tailoring and maintenance of the Ares 1-X FS DRDs.

11) Provide support for Technical Working Groups and panels to support system design, analysis, and integration for the Ares 1-X FS.

12) Provide support to Ares 1-X FS Trade Studies.

13) Provide specific system integration engineering functions in the support of Ares 1-X FS. Functions include support to system and element level trade studies, assessment of interfaces and between subsystems, assessment of top level related requirements and verification planning, and schedule/cost inputs. This function will provide the planning, leadership and integration of the system analysis and design activities across the Ares 1-X First Stage in lieu of a formal IPT and be responsible for maintaining knowledge or documentation of the status of the analysis and design of all the elements and insuring this information is communicated across the element. This function will support the various element leads and ensure communication amongst the engineering discipline working Ares 1-X FS as well as interfaces to those supporting US and Ground Operations.

- **Skill set required**: Hands on experience of 20 years or more (preferred) in performing Systems engineering oriented analytical and hardware/software integration on various manned space flight programs from program inception (System Requirements Review-SRR) through launch and recovery. Technical expertise in propulsion may be needed. Experience required in conducting, coordinating and executing the activities for program/project milestone reviews including SRR, SDR (System Design Review), PDR (Preliminary Design Review), CDR (Critical Design Review), PSR (Pre-Shipment Review), FCA/PCA (Functional Configuration Audit/Physical Configuration Audit), IRR (Integration Readiness Review), DCR (Design Certification Review) and FRR (Flight Readiness Review).

3.2 Specialized Systems - Engineering and Integration Support for Vehicle Integration (VI)

The contractor shall provide specialized system engineering and integration support for the Vehicle Integration (VI) office; Design and Analysis Working Group, Vehicle Integration Group (VIG), Systems Engineering Management Plan (SEMP) implementation/maintenance, Systems Analysis Planning (SAP) implementation/ maintenance, Design and Construction Standards, Specifications assessment, Requirements evaluation; Verification planning/execution, Flight and Ground Hazards coordination, Risk Management and coordination, Systems Simulation, Trades and Analysis and ConOps.

The contractor shall provide support for any of the following SE&I VI sub-tasks:

3.2.a. Vehicle Integration Development Support - Closed February 2008

1) Provide a Requirements Coverage / Integration Support Lead which is responsible for development, population and maintenance of the Requirement Coverage Matrix (RCM) and other internal working and reporting products.

2) Provide Flight & Integration Test Office (FITO) / Verification and Test Integrator(s) which will support VI to ensure Major Verification/Test activities (e.g. Main Propulsion Test Article {MPTA}; Ground Vibration Test / Systems Integration Laboratory {GVT/SIL}; integration; and, coordination. This task will coordinate with the latest Integrated Vehicle Design Definition Document (IVDDD) to ensure proper Ares representation within all FITO documentation.

3) Provide FITO / Verification and Test Integrator(s) which will provide direct support to VI to ensure Major Verification/Test activities (e.g. MPTA/GVT/SIL) integration and coordination. This task will coordinate with the latest IVDDD to ensure proper Ares representation within all FITO documentation.4) Provide a Planning and Vertical Integration Interface Lead which is responsible for providing direct technical support to VI to ensure design and analysis integration and coordination.

5) Provide a Database Lead which is responsible for providing direct technical support for database and IT expertise for Ares IRD / SRD Requirements, TBD/TBR resolutions, risk mitigations, etc. using the Cradle, WindChill, SharePoint, IRMA (ARM) and other database tools.

3.2.b. Analytic Integration Support - RESERVED

6) Provide systems engineering support for Vehicle Integrated Analyses including:

- Responsible for the analytical integration of the VIO and Element designs, models and analyses of the integrated Ares 1, focusing on interfaces among VIO WBSs and Elements and the sensitivities and interactions of the VIO WBSs, Elements and subsystems as an integrated system.
- Assure the technical balance and adequacy of the integrated vehicle design:
  - Lead analysis activity that incorporates the system-level analyses into an integrated vehicle analysis,
  - Provide iterative design support to subsystem designers to improve design quality and fidelity
  - Make recommendations relevant to design optimization
  - Identify subsystem analyses trade deficiencies/inconsistencies
- Provide Verification / Requirements assessment
- Support the integrated modeling and simulation of the Ares 1 system
- Support the execution of system level trades and performance of vehicle systems analysis across disciplines, VIO WBSs and Elements including but not limited to performance, operability and risk.

7) Provide systems engineering support for Integrated CAD Modeling including producing for element inputs, an integrated CAD model of the Ares to be used for all design and analysis at Level 3 and Level 2 for the purpose of development, configuration management, and update of the assemble and integration sequence drawings that document the interfaces among FS, US, Orion and Ground Systems.

- **Skill set required**: Hands on experience of 20 years or more (preferred) in performing analytical and hardware integration on various manned space flight programs from program inception (SRR) through launch and recovery. Experience required in conducting, coordinating and executing the activities for program/project milestone reviews including SRR, SDR, PDR, CDR, PSR, FCA/PCA, IRR, DCR and FRR.

3.3 Specialized Systems - Engineering and Integration Support for Integrated Design and Analysis (ID&A) - Closed February 2009

1) The contractor shall provide program management specialists in the integration of integrated vehicle design and analyses, including, but not limited to, vehicle requirements analysis, modeling and simulation, design analysis cycle planning and execution, and verification methods. The contractor shall support and/or lead, as needed, IDA work package discipline integration, DAC planning, implementation, and re-integration tasks and work with the Level 3 design and analyses working group and other working groups and integration groups as needed.

2) The contractor shall directly support IDA work package manager for fulfilling IDA work package responsibilities including integration, technical implementation, and the on time delivery of quality products to the VI project office and other customers. Integration responsibilities shall include planning, evaluations, status of technical disciplines, establishing, tracking, coordinating, and addressing technical actions from project and engineering. Responsibilities shall also include supporting and/or providing, as needed, status reviews and project monthly reviews and associated metrics and risk identification, mitigation, and tracking responsibilities for IDA. The contractor shall support SRD, IRD, DRD requirements coordination and technical resolutions as needed. The contractor shall conduct and support trade study planning, Level 2, Level 3, and Level 4 coordination as needed.

3) The contractor shall perform or lead trade study and decision analysis efforts, including technical disciplines, and facilitate decision making for a wide range of Ares I technical issues.

4) The contractor shall evaluate technical quality, status, and provided integration of analyses and design products and documentation in support of vehicle design, development, operational flight tests and flight operations for the Ares program.

5) The contractor shall provide subject matter expert support to verification and validation activities for models and simulations used for IDA work package. The contractor shall review technical reports, requirements documents, engineering memorandums for technical adequacy and content.

6) The contractor shall provide technical subject matter expertise for integration, but not limited to, of the following IDA disciplines for human rated space launch vehicle or similar vehicle:

- Guidance and navigation algorithm development, implementation, and assessment
- Flight control system performance determination through linear stability analyses; and 3-degree of freedom (DOF) and 6-DOF simulation implementation, development, and analyses.
- Static and dynamic structural loads determination through estimation, analyses, and tests, including finite element analyses.
- Aero-elastic analyses
- Trajectory and performance analyses
- Determination of valid ranges for Vehicle/discipline specific Monte Carlo dispersions.
- Aerodynamics, aero-thermal, flight acoustics analyses
- Thermal analyses
- Propulsion and lift-off acoustics
- Solid and cryogenic liquid systems
- Mass properties estimation techniques and CAD integration

7) The contractor shall support Constellation/VI project office with architecture integration activities including architecture development and feasibility analyses, physical configuration definition, architecture reference documentation, mission modeling and simulation.

8) The contractor shall support analytical integration activities between Ares, Level II and the Ares Level IV elements including Ares Design Analysis Cycle (ADAC) / Constellation Integrated Design Analysis Cycle (IDAC) / Orion Design Analysis Cycle (ODAC) coordination as needed. The contractor shall support identification, preparation and implementation of analyses and trade studies efforts, documentation and presentation of related work to the various working groups and control boards, as well as issues tracking and resolution. The contractor shall support development of the ADAC / IDAC plans, integrated analysis schedules, as well as requirements coverage and design feasibility assessments.

9) The contractor shall provide requirements development and verification support.

- **Skill set required**: Hands on experience of 15 years or more (preferred) in performing analytical and hardware/software integration on various manned space

- flight programs from program inception (SRR) through launch and recovery. Extensive experience (preferred) in, but not limited to, the following focus areas:
    - Vehicle integration for human rated space launch vehicle or similar vehicles
    - Planning and executing vehicle design and analyses cycles
    - Three and six degree of freedom (3-DOF and 6-DOF) simulations to determine system level performance and margins. Past MAVERIC experience is desired.
    - Monte Carlo dispersion analyses techniques

    - Integrating the following disciplines for design, analyses, and flight operation of human rated space launch vehicle or similar vehicle. Also, direct experience with the following discipline areas is desired
        - Guidance, navigation and control architecture and algorithm design and analyses, 3-DOF and 6-DOF flight dynamics analyses
        - Vehicle Loads, dynamics, and strength for all phases of ground and flight operations, including 3-D finite element, transient, buffet, wind gust, slosh, flex, vibro-acoutics and aero-elastics analyses.
        - Trajectory design/analyses and Monte Carlo dispersion analyses techniques
        - Range safety analyses and requirements
        - Aero-dynamics and CFD analyses for ascent flight.
        - Aero-thermal analyses including ascent, separation, re-entry aerodynamic heating
        - Acoustics analyses for lift-off, ascent flight, and propulsion systems
        - Thermal and venting analyses between vehicle elements
        - Mass properties predictions for flight configurations
        - Requirements for natural environments (i.e., weather and winds).
        - Aero, aero-thermal, acoustics, loads and vibration testing.
    - Knowledge in systems requirements analysis, risk identification and mitigation, modeling and simulation, and verification approaches for complex, multi-element aerospace systems
    - NASA and/or DOD requirements development and verification process
    - Space Shuttle vehicle or other similar space vehicles and programs.
    - Leading and facilitating trade studies on complex aerospace problems involving evaluation of technical, cost, and schedule issues with associated risk
    - Project planning and management

- Coordinating meetings/reviews, preparing review presentations, and consolidating review comments and action items
- Conducting, coordinating and executing the activities for program/project milestone reviews including SRR, SDR, PDR, CDR, PSR, FCA/PCA, IRR, DCR and FRR.

3.4 Specialized Systems - Engineering and Integration Support for Upper Stage (US) SE&I

The contractor shall provide specialized system engineering and integration services, but not limited to, the Systems Engineering and Integration (SE&I) functions for the Integrated Upper Stage; SEIWG (Systems Engineering and Integration Working Group), Systems Engineering Management Plan (SEMP)maintenance/implementation, Engineering Requirements Document (ERD), Interface Requirements Documents (IRDs), Verification planning/execution, Control Plans, CM/DM, Interface Control Documents (ICDs), Flight and Ground Hazards, FMEAs, Risk, Systems Simulation, Trades and Analysis, Operational Concepts, OMRSDs, and OMIs.

3.4.a. US SE&I Management Support - Closed June 2010

1) The contractor shall provide technical discipline and technical coordination expertise supporting the Ares-I US SE&I management activity and products required in the development of the integrated US flight article, and for major integrated US test articles (such as the Main Propulsion Test (MPT) and US proportion of Ground Vibration Test (GVT).

2) The contractor shall support various technical discipline panels (e.g., Thermal, Loads, Aero, AFSIG) & Level 3 Ares-I integration meetings representing Upper Stage SE&I.

3) The contractor shall provide SE&I support for the delivery of US element products to the Project Office (PO). Provide technical, financial and schedule status to the PO in support of Earned Value Management. Support schedule management across engineering disciplines in support of the integration effort.

4) The contractor shall provide support to the US Design Analysis Cycle (DAC) planning, execution, integration, and reporting efforts. Work with engineering and project personnel at Level 3 Ares I PO to ensure US DAC planning, execution, integration, and reporting efforts are coordinated with and complimentary to Ares I level DAC activity and schedules. Identify and work to resolve DAC integration activities between US subsystem Integrated Product Teams (IPTs) and between the US and Level Ares I project.

5) The contractor shall provide technical expertise in the implementation and operation of systems engineering tools in support of Upper Stage SE&I activities (Cradle, Windchill, DDMS)

6) The contractor shall provide technical expertise and assistance to the US PO in development and maintenance of program plans and associated implementation methodologies. Review and guidance for the implementation of Level II and level II program requirements and changes is to be provided.

3.4.b. US Requirements and Verification Support

7) The contractor shall support system engineering activities in the development, documentation, and maintenance of the US element requirements. Provide for the review, analysis, decomposition, allocation and derivation of requirements, including US external and internal interface requirements. Provide support to the development of requirements verification methods and objectives, and management of requirements changes for the US element and subsystems.

3.4.c. US Configuration and Data Management Support - RESERVED

3.4.d. US System Design Support

The following task(s) are a part of US SE&I system design activities:

9) The contractor shall support Systems Engineering and Integration Working Group (SEIWG) and US Integrated Performance Analysis Team (IPAT) meetings and related activities for US SE&I. Support the development of and US design documentation, plans, and analysis reports for US SE&I. Provide review comments and recommendations for US, Ares-I and Constellation Program design documentation, plans, and analysis reports for US SE&I.

10) The contractor shall support and manage formal Trade Studies & ad hoc special studies for US SE&I. Lead and support study planning, implementation, integration,

status & documentation, and develop recommendations for US SE&I and US project Office management.

11) The contractor shall provide subject matter expertise in launch vehicle development, design analysis, trade studies, requirements development, risk mitigation, and technical assessments.

12) The contractor shall support the development of and provide input to various integrated data-book efforts (i.e., DAC data book, Thermal data book, Loads data book, etc.).

- **Skill set required**: Hands on experience of 20 years or more (preferred) in performing systems engineering focused analytical and hardware/software integration on various manned space flight programs from program inception (SRR) through launch and recovery. Experience required in conducting, coordinating and executing the activities for program/project milestone reviews including SRR, SDR, PDR, CDR, PSR, FCA/PCA, IRR, DCR and FRR.

3.5 Specialized Systems - Engineering and Integration Support for Vehicle Integration Ares Launch Site Integration and Assembly Analysis and Planning - Closed October 2009

The following task shall be performed to support the Vehicle Integration Ares Launch Site Integration and Assembly Analysis and Planning:

1) The contractor shall perform the following analysis tasks:
- Develop and maintain functional flows (typically represented by block diagrams).
- Develop, implement and maintain functional allocation (allocates functions to personnel, hardware, software, or combinations).
- Develop and maintain decision/action diagrams (DADs).
- Develop, implement and maintain task analysis and can be simply a list of all the tasks that a human must perform on a piece of hardware. This list is simplistic early in design and becomes detailed later.
- Human engineer *must* work hand-in-glove with mechanical design at the element and vehicle level, with connector selectors, with cable designers (includes total hardware/software interface integration). He will point out the applicability of the requirements to them and has the broadest insight into the design associated with and in the vicinity of this task. The Human Engineer thus performs an essential integration function through the design development phase, and this engagement is based on the content of the task analysis.
- Develop, implement and maintain worksite analysis which is highly dependent on the task analysis. A worksite analysis is performed for each task using the standard tool of Delmia's human module (formerly ERGO {ERGOnomics}, now the module which includes the Safework human

- model). The models will need to be useful to all other organizations that might need them.
- Develop, build and deliver mockups. This is a traditional human factors/human engineering approach.

Skill set required: Hands on experience of 20 years or more (preferred) in performing systems engineering oriented analytical and hardware/software integration on various manned space flight programs from program inception (SRR) through launch and recovery. Experience required conducting/coordinating/executing the activities for program/project milestone reviews including SRR, SDR, PDR, CDR, PSR, FCA/PCA, IRR, DCR and FRR.

3.6 Specialized Systems - Engineering and Integration Support for Avionics/Software Integration - Closed February 2008

The contractor shall provide System Design, engineering and integration services via specialized technical expertise in the area of avionics/software integration to all levels of customers including program managers and chief engineers in the Exploration Launch System Office including, but not limited to, Level 2 Constellation (CxP), Ares and associated elements, Orion {alias Crew Exploration Vehicle (CEV)} and Cargo Launch Vehicle (CaLV). This task shall include all aspects of integrated avionics/software functions including, but not limited to, Instrumentation Program and Command List (IP&CL) development, coordination and maintenance, electrical power, Electromagnetic Compatibility/Electromagnetic Interference (EMC/EMI) analyses,
Command, Control, Communications, and Information (C3I) analyses, Electrical, Electronic, and Electromechanical (EEE) analyses, software development assessments and coordination related to data bus traffic and sensor information and verification-related task coupled with the avionics/software vehicle integration effort.

- **Skill set required**: Hands on experience of 25 years or more (preferred) in performing analytical and hardware integration on various manned space flight programs from program initiation (SRR) through launch and recovery. Experience required conducting/coordinating/executing the activities for program/project milestone reviews including SRR, SDR, PDR, CDR, PSR, FCA/PCA, IRR, DCR and FRR.

3.7 US – Stage Definition Systems Engineering Support

The contractor shall provide engineering technical expertise to support to Upper Stage (US) Systems Engineering and Integration (SE&I) organization and in particular the Design Integration Working Group (DIWG) by participating as member(s) of the Engineering Integration Team (EIT). Experience with propulsion systems is required in order to coordinate for the US SE&I Office all the various aspects of the various propulsion systems contain within the US design. The systems

engineering expertise will facilitate, coordinate and expedite the work package task activities with the DIWG and associated IPTs and other working groups (Level V, Level IV, and Level III), during the design process for the US. Also included is support/participation in technical reviews such as SRR, SDR, DCR, PDR, etc.

3.8 US Integrated Test Support

The purpose of this task is to provide assistance to Marshall Space Flight Center Stage Systems Engineering & Integration Division (EV80) in conducting the required systems engineering and integration efforts to lead and develop technical management framework for the MSFC Engineering Directorate. The initial task for products include a summary and presentation of current NASA MSFC capabilities and standards to understand gaps and issues to develop a future capabilities for Engineering that may include automated interfaces and processes to help NASA MSFC be efficient and accurate on current and future projects. The specific task areas would include, but are not limited to: to provide expertise, understanding and knowledge of current NASA Engineering processes and capabilities to lead and develop a technical management framework; resolving testing and developmental issues for the propulsion systems, upper stage segments and other vehicle stages as required by the spacecraft and vehicle engineering division; planning and coordination for design, manufacturing, hardware assembly and checkout of test article subsystems; providing support and coordinate the development of change packages for the Upper Stage design and development; and other systems engineering and integration tasks as specified and directed by the Spacecraft and Vehicle engineering Division at Marshall Space Flight Center. The Contractor shall participate, as directed, in various Technical Working Group (TWG) meetings, interface with the System Integration Groups (SIGs), and participate in monthly reviews and / or telecons to collect the required information for supporting these task processes.

3.9 US Integrated Stage Operations Support - Closed June 2010

3.10 US Ground Vibration Test Support - Closed June 2010

3.11 US Integrated Systems Test Support - EV81 - Closed May 2009

3.12 US Integrated Systems Test Support - EV83 - Closed June 2010

3.13 Ares V EDS Support

The contractor shall support system engineering activities in the development, documentation, and maintenance of the Ares V element requirements. Provide for the review, analysis, decomposition, allocation and derivation of requirements, including external and internal interface requirements. Provide support to the development of requirements verification methods and objectives, and management of requirements changes for the Ares V element and subsystems.

3.14 US Element Management Support - Closed June 2010

3.15 Ares V Requirements Development Support

The Contractor shall provide systems engineering support of requirements development and analyses, SE&I, requirements validation, element level Verification & Validation planning in support of integrated vehicle level V&V efforts, internal interface requirements document (IIRD) development, management & requirements integration for the Ares V First Stage. The contractor shall be an integral part of the integrated Level III and IV requirements development effort in support of progressing to SRR. The Contractor will develop and document project/element constraints, system functional analysis, decomposition, and allocation to the elements' subsystems and element conceptual design integration (including trade studies) required to synthesize the element architecture with the requirements set. Work will require support to, as well as leadership of, teams of engineers engaged in similar activities necessary to develop an integrated requirements set as well as the supporting conceptual element design.

3.16 RESERVED

3.17 Specialized Systems - Engineering and Integration Support for Technical Management Framework for Future Vehicle Integration Activities

Utilizing lessons-learned from experience in the design, engineering, and planning of the Constellation family of vehicle, specifically the Ares I, the Contractor shall support the review, design, establishment and execution of a common technical management framework for future engineering efforts. The Contractor shall provide assistance to Stage Systems Engineering & Integration Division in conducting the required systems engineering and integration efforts to lead and plan the development of a technical management framework for the MSFC Engineering Directorate. The Contractor shall provide a summary and presentation of current NASA MSFC capabilities and standards to understand gaps and issues to develop future capabilities for MSFC Engineering that may include automated interfaces and processes to help NASA MSFC be efficient and accurate on current and future projects. The specific task areas would include, but are not limited to: to provide expertise, understanding and knowledge of current NASA Engineering processes and capabilities to support the development of a technical management framework; resolving testing and developmental issues for systems, stage(s) segments and other vehicle stages ; planning and coordination for design, manufacturing, hardware assembly and checkout of test article systems/subsystems; providing support and coordinate the development of change packages for the stage(s) design and development; and other systems engineering and integration tasks as directed. The Contractor shall participate, as directed, in various Technical Working Group (TWG) meetings, interface with the System Integration Groups (SIGs), and participate in status reviews and / or telecons to collect and forward the required information for supporting these processes.

3.18 Spacecraft and Vehicle Systems Stage Design & Integration Support *(Authorization to proceed with this subtask will be provided by the Contracting Officer in written direction.)*

The Contractor shall provide launch vehicles and spacecraft support including, but not limited to, expertise in support of requirements; interfaces; verification; integrated design and analysis; integration tasks including avionics/software integration, launch site integration and planning; and systems engineering for MSFC, including but not limited to, the departments, divisions and branches within the Engineering Directorate, including the Stage Design and Integrated Branch; and Project and Programs that MSFC has responsibilities. Tasks shall include requirements allocation, decomposition and derivation, as well as Change Request evaluations of SRDs, IDDs, ICDs, IRDs, and ERDs, and test documents in preparation for reviews.

The contractor support shall include providing specialized Systems Engineering and Integration Support for Future Vehicle Integration Activities including, but not limited to; expert level understanding and knowledge of current NASA engineering standards, processes and capabilities to lead, plan and assist MSFC and Vehicle Systems Department including, the Stage Design and Integration Branch in conducting the required systems engineering and integration efforts to lead and plan the development of a technical management framework for the MSFC Engineering Directorate to resolve testing and developmental issues for the propulsion systems and vehicles stages.

3.19 Spacecraft & Vehicle Systems Stage Test & Flight Evaluation Support *(Authorization to proceed with this subtask will be provided by the Contracting Officer in written direction.)*

The Contractor support shall include, but not limited to, Integrated System Test support, planning and operations to include, but not limited to, the Stage Test and Flight Evaluation Branch. The support provided shall encompass specialized system engineering and integration services for vehicle hardware implementation functions that will include, but will not limited to, Systems Engineering and Integration Support for Future Vehicle Integration Activities utilizing expert level understanding and knowledge of current NASA engineering standards, processes and capabilities to lead, plan and assist MSFC Spacecraft and Vehicle Systems Department including, the Stage Test and Flight Evaluation Branch in conducting the required systems engineering and integration efforts to lead and plan the development of a technical management framework for the MSFC Engineering Directorate to resolve testing and developmental issues for the propulsion systems and vehicles stages; Stage Integration Working Groups participation/coordination; Master Test Plans; Detailed Test Plans, Test Implementation Plans; Test Operations Plans; Test Analysis Plans, Test Article to Test Stand ICD's, Test Article IRD's: Test Article Master Measurements List; Test Article Configuration Definition Documents; Flight Vehicle Manufacturing Plans, Flight Vehicle Logistics plans, GSE Definition Plans and Test Hardware Procurement Strategies.

4.0 Travel

The contractor shall travel as requested to accomplish each technical requirement. Any travel must be approved by the Contractor Officer's Technical Representative (COTR) or task order technical monitor, prior to travel.

The contractor's monthly report shall contain travel detail to include travel destination, dates of travel, number of people who traveled, and purpose of the travel.

5.0 Materials

No materials are currently required for this order. However, this may change based on the customer's requirements as directed by the Contractor Officer's Technical Representative (COTR) or task order technical monitor. Any materials being purchased must be approved by the Contracting Officer prior to purchase.

6.0 Reserved

7.0 Personnel Skill Levels

The contractor shall provide skills at a level to perform the subtasks in this order.

8.0 Technical Milestones and Deliverables

Specified under Section 2.B of the SOW; any additional deliverables for specific subtasks are specified under Section 3.0