

**National Aeronautics and Space Administration  
Ames Research Center  
Moffett Field, CA 94035-0001**

**STATEMENT OF WORK**

**SMALL SPACECRAFT PROTOTYPING  
ENGINEERING DEVELOPMENT & INTEGRATION  
(SSPEDI)**

**Space Solutions  
(SpS)**

**Date: November 3, 2017**

STATEMENT OF WORK  
SMALL SPACECRAFT PROTOTYPING ENGINEERING DEVELOPMENT & INTEGRATION  
SPACE SOLUTIONS (SpS)

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## **1 Scope**

This Statement of Work (SOW) defines requirements for Space Solutions (SpS). Specific elements of work, within the scope defined here, will be issued in separate task orders. This SOW describes the technical and programmatic work that the Contractor will perform to manage and execute projects for the development of spacecraft, payloads, buses, spacecraft subsystems, software, components, and ground systems. This activity will also include support for the deployment of spacecraft and ancillary systems and project operations based on technical, schedule, and cost requirements defined in each specific task order. The requirements for each project will be competed among the SpS contractors and awarded as a separate and distinct task orders.

## **2 System Architecture**

The requirements of this contract are to rapidly develop systems associated with spacecraft/space vehicles that provide advanced capabilities in support of demonstration and operational projects. Those capabilities are envisioned to cover a broad range of projects, to include small and medium satellites, nominally up to 500 kg, with a focus on high quality, yet rapid development, manufacturing and integration and test elements. In addition, the systems may use open source standards and modular space vehicle architectures to allow a wide spectrum of integration options for payloads and other systems.

The tasks will require project management, engineering, craft and technical skills, as well as logistical elements including IT system operations, and ancillary services, to deliver space vehicle hardware, integrated systems, and solutions.

## **3 Requirements**

The Contractor shall manage technical, schedule and cost performance necessary to meet the requirements as defined in each task order. Services shall be conducted at the Contractor's facilities and/or at other facilities as directed by the Government. Lastly, the Contractor must be certified at the Top Secret Sensitive Compartmented Information (TS/SCI) level to have access and manage work in a classified environment. The contractor shall have the ability to provide personnel with current TS/SCI with current completed Program Access Request (PAR) forms and Standard Form 86, Questionnaire for National Security Positions (SF 86).

Requirements for the projects performed within this SOW are described below. They are organized in a typical spacecraft project lifecycle fashion.

### **3.1 Project Definition**

- 3.1.1 Perform concept studies, develop concepts of operations, and provide solution options. Concept studies are typically performed before formulation of a project with the expected result of producing documentation that captures and communicates a feasible concept that meets the goals and objectives of the project, including results of analyses of alternative concepts, the concept of operations, preliminary risks, and potential de-scopes. It may include images, tabular data, graphs, and other descriptive material.

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### **3.2 Planning Requirements**

The Contractor shall develop a set of project planning documents that will be periodically updated over the project lifecycle as designs mature.

- 3.2.1 Establish, maintain, and use in the performance of this contract, an Earned Value Management System (EVMS). The correlation and integration of these systems and processes shall provide for early indication of cost and schedule problems, and their relation to technical achievement.
- 3.2.2 Support the development of a project plan for, which includes the technical approach to meeting the requirements. This will also include a Concept of Operations; data collection, processing, and analysis plans; and a test plan that includes verification and validation of system capabilities and requirements.
  - 3.2.2.1 Develop a Concept of Operations approach that shall focus on plans and procedures for end-to-end project operations and including plans, processes, and procedures for factory testing, delivery, and transition of operations to the end user.
- 3.2.3 Develop a Bus Plan for developing and manufacturing a spacecraft bus to satisfy the space vehicle project and an acquisition plan for hardware/software subsystem components, as required. This plan typically includes step-by-step instructions and procedures for the assembly, integration, testing, disassembly, and storage of the bus and sub-assemblies. The plan shall be sufficient for transitioning to overall space vehicle integration and support re-use for similar current or future requirements.
- 3.2.4 Develop a Payload Plan for developing and manufacturing a payload to satisfy the space vehicle project and an acquisition plan for hardware/software subsystem components, as required. This plan shall include step-by-step instructions and procedures for the assembly, integration, testing, disassembly, and storage of the payload and sub-assemblies. Instructions and procedures shall be sufficient for transitioning to overall space vehicle integration and support re-use for similar current or future requirements.
- 3.2.5 Develop a Ground Support Systems Plan for the development of necessary ground support systems associated with the spacecraft systems. This shall include step-by-step instructions and procedures for the assembly, integration, testing, use, disassembly and storage of ground support systems provided. The instructions / procedures shall be sufficient for transitioning to overall space vehicle integration and support re-use for similar current or future requirements.
- 3.2.6 Develop an Space Vehicle Integration Plan for the integration of the bus and payload into the final space vehicle. This plan will incorporate the instructions delivered from the bus and payload developers into a full space vehicle set of instructions and the step-by-step instructions and procedures for space vehicle assembly, integration, test, and disassembly.
- 3.2.7 Develop, maintain, and publish a Requirements Verification Matrix for the bus, payload, and ancillary systems as required to demonstrate that the system being delivered by the Contractor meets all technical performance requirements. The expectation of the Requirements Verification Matrix is that it establishes the minimum verification documentation required for proceeding to launch integration. Recommend approaches

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and revisions to current practices that improve any combination of technical quality, risk reduction, cost, and schedule without adversely affecting the others. Provide instructions to the Government in support of future use of the delivered hardware or for process refinement on similar hardware.

- 3.2.8 Conduct requirements analyses and assessments for manufacturability and testability.

### **3.3 Design Requirements**

The Contractor shall develop a designs that will be periodically updated over the project lifecycle. These design requirements will consist of the following:

- 3.3.1 Completion of specification development and system design (concept to detail) for space vehicle (i.e. payload, subsystems including software, and components) and ground systems and integration with launch services that can be shown to support open interface standards and re-use for similar current or future requirements.
- 3.3.2 Meet overall manufacturing, deployment, and project operational requirements including but not limited to interface requirements, vehicle assembly and integration, launch vehicle requirements, launch integration requirements, pre-launch checkout, post launch checkout/turn-on, calibration, and compatibility with ground system components, end-to-end demonstrations, and mission operations.

### **3.4 System Engineering and Analysis Requirements**

The Contractor shall perform systems engineering and analysis throughout the project lifecycle consisting of the following:

- 3.4.1 Systems engineering, requirements definition, analysis and allocation, trade studies and simulations throughout the project lifecycle phases in order to provide adequate technical refinement of the project as needed, and provide timely support the development and test project phase.

### **3.5 Project Reviews**

The Contractor shall support various project level reviews that will typically consist of the following:

- 3.5.1 Systems Requirements Review (SRR) that will encompass the entire project, focusing on assessment of the overall project plan, top level technical requirements, systems engineering methodology and simulation, component system performance projections/capabilities, requirements flow down and low-level specification allocations, risk assessment (including hardware and software) that is tied to the planned risk reduction and prototyping tasks.
- 3.5.2 Preliminary Design Review (PDR) to establish the allocated system baseline for Government approval.
- 3.5.3 Critical Design Review (CDR) that enables a multi-disciplined product and process assessment to ensure the system is ready to proceed into system fabrication, software development, demonstration, test, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), and risk, as defined in each

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task order. CDR support includes providing a detailed CDR schedule which may contain separate bus and payload design reviews leading to the final space vehicle CDR. The schedule shall highlight specific long lead items which would require early approval or release to meet program critical milestones.

### **3.6 Risk Management Requirements**

The Contractor shall implement a comprehensive and robust risk management program that includes the following at a minimum:

- 3.6.1 The Contractor shall identify potential technical and programmatic risks.
- 3.6.2 The Contractor shall assess the potential likelihood and consequences of the identified risks, based on criteria provided by the task orders.
- 3.6.3 The Contractor shall provide a risk mitigation plan for risks that exceed the project classification threshold. Identified risks, risk management approach, mitigation plans and status shall be communicated to the Government as a part of periodic project reviews

### **3.7 Manufacturing and Acquisition Requirements**

During performance of this contract the Contractor may need to procure components and services from others. The Contractor will be required to ensure traceable methods for the acquisition of flight hardware components and systems. These elements of manufacturing and system acquisition include:

- 3.7.1 Develop, procure, fabricate and/or otherwise provide spacecraft, payloads, buses, spacecraft subsystems, software, components, and/or ground systems that may require:
  - 3.7.1.1 Manufacturing facilities, laboratories, tooling, test equipment, component assessment, and controlled handling equipment;
  - 3.7.1.2 Software to include flight software for spacecraft turn-on, check-out, calibration, and operations (e.g. data acquisition, communications) and support of ground operations;
  - 3.7.1.3 Continual custody systems, testbeds, and related infrastructure for ground equipment and systems (e.g. informational, electrical, mechanical) to support capabilities;
  - 3.7.1.4 Integrated logistics and procurement support including material planning and control, inventory management, acquisition, shipping and receiving; and
  - 3.7.1.5 Listing of procured materials as defined from the design.

### **3.8 Assembly, Integration, and Testing Requirements**

- 3.8.1 Develop and update, as necessary, plans for, and execute the assembly, integration, and/or testing of, the spacecraft, payloads, buses, spacecraft subsystems, software, components, and ground systems.
- 3.8.2 Conduct parts analysis and testing, component preparation and conversion as required to allow parts to be used in a production or production like environment.
- 3.8.3 Conduct tests of the integrated system/solution, including command and control, and ground systems.

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### **3.9 Deployment and Flight Support Requirements**

- 3.9.1 Provide or acquire specialized shipping, ground storage prior to deployment, the storage of spares and specialized equipment - any of which may include purge, shock, and/or contamination related requirements.
- 3.9.2 Support the development and execution of pre-launch procedures including criteria for spacecraft related 'go-for-launch' decisions.
- 3.9.3 Support spacecraft (or other solution/capability) deployment including training, launch support, turn-on procedures, spacecraft check-out and calibration, trouble shooting, and anomaly resolution.

### **3.10 Termination Support Requirements**

- 3.10.1 Support spacecraft termination definition including deorbit, disposal, and/or retrieval as required.

### **3.11 Additional Requirements**

- 3.11.1 The Contractor shall follow professionally accepted standards, processes, and tools for project and technical management, including configuration management, risk analysis and management, systems engineering and analysis, quality assurance, digital assurance, verification and validation, mission assurance, and safety reviews
- 3.11.2 The Contractor shall use the Modular Open System Approach (MOSA) and autonomous manufacturing to the maximum extent practical as specified in the subsequent task orders.

### **3.12 Task Order Management**

- 3.12.1 The Contractor shall develop and maintain a project management plans. This plan will include a Work Breakdown Structure (WBS) to be delivered 30 days after award, and then updated, as required in subsequent task orders.
- 3.12.2 The Contractor shall establish and maintain program schedules and cost baselines, and track actuals.
- 3.12.3 The Contractor shall deliver periodic reports and conduct periodic reviews as directed (nominally monthly). The Contractor shall identify cost, schedule, technical issues, and risks and report them to the Government as soon as is practical.

### **3.13 Project Meetings, Reviews, and Training**

- 3.13.1 The Contractor shall host a kick-off meeting at task order award to review and introduce its organization, management and technical processes, program plan, cost, schedule, technical, requirements and risk assessments.
- 3.13.2 The Contractor shall conduct and/or support Technical Interchange Meetings (TIMs) with the Government, potential bus, payload and/or satellite vehicle vendors and potential ground segment providers as needed to identify, resolve, and establish architecture, technical interface, assembly and integration activities/direction.

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- 3.13.3 The contractor shall conduct Project Management Review (PMR) meetings as defined in subsequent task orders. During the reviews, the contractor shall present integrated cost, schedule, and technical performance status. Integrated Product Team leads or functional managers shall include cost information in discussions of schedule status, technical performance, and risk using earned value management as an integrating tool. The following shall be addressed: Cost/schedule trends, significant cost/schedule technical variances, projected impacts, quantified risk assessments, and corrective action plans.
- 3.13.4 The Contractor shall engage with the Government's program manager in Integrated Baseline Reviews (IBRs) to evaluate the risks inherent in the task order's planned performance measurement baseline when EVM is applicable to the task order. Initially, this shall occur as soon as feasible but no later than six months after contract award, and subsequently following all major changes to the baseline. Each IBR should verify that the contractor is consistent with cost, schedule, technical approach, and risk plans. The prime contractor shall lead the subcontractor IBRs, with active participation by the Government. (See NFS 1852.234-2)
- 3.13.5 The Contractor shall establish, conduct, and/or support training activities in support of providing and deploying the capability including but not limited to fabrication, assembly, integration, testing, pre-launch support, launch, deployment, turn-on, check-out, calibration, operations including command and control and other ground systems, and termination.
- 3.13.6 The contractor shall conduct and/or support a project Closeout Meeting with the Government.

### **3.14 Security & Information Assurance (IA)**

The Contractor shall comply with the security and information standard specified at the task order level.

## **4 Deliverables**

Specific technical and programmatic deliverables will be defined in the task orders issued under this contract.

### **4.1 Documentation**

The Contractor shall prepare and maintain program, design, test, and other relevant documentation in accordance with its program plans and the following Contract Data Requirements List contained in each task order.

## **5 Applicable Documents**

The Contractor shall comply with current applicable NASA and DOD policies and procedures, as required in each applicable task order.