

ORS Modular Space Vehicles (MSV)

Multi-Mission Modular Bus Development Task Order

J.1(a) attachment 5

28 January 2010

ORDER FOR SUPPLIES OR SERVICES	PAGE OF PAGES
IMPORTANT: Mark all packages and papers with contract and/or order numbers.	1

1. DATE OF ORDER TBD	2. CONTRACT NO. (If any) TBD	6. SHIP TO:	
3. ORDER NO. TBD	4. REQUISITION/REFERENCE NO. TBD	a. NAME OF CONSIGNEE Patricia B. Hudson	
5. ISSUING OFFICE (Address correspondence to) NASA Ames Research Center		b. STREET ADDRESS NASA Ames Research Center, MS 241-1	
7. TO:		c. CITY Moffett Field	d. STATE CA
a. NAME OF CONTRACTOR		e. ZIP CODE 94035-1000	
b. COMPANY NAME		f. SHIP VIA FOB Destination	
c. STREET ADDRESS		8. TYPE OF ORDER	
d. CITY	e. STATE	<input checked="" type="checkbox"/> a. PURCHASE <input type="checkbox"/> b. DELIVERY -- Except for billing instructions on the reverse, this delivery order is subject to instructions contained on this side only of this form and is issued subject to the terms and conditions of the above-numbered contract.	
9. ACCOUNTING AND APPROPRIATION DATA		10. REQUISITIONING OFFICE	

11. BUSINESS CLASSIFICATION (Check appropriate box(es))				12. F.O.B. POINT
<input type="checkbox"/> a. SMALL	<input type="checkbox"/> b. OTHER THAN SMALL	<input type="checkbox"/> c. DISADVANTAGED	<input type="checkbox"/> g. SERVICE-DISABLED VETERAN-OWNED	
<input type="checkbox"/> d. WOMEN-OWNED	<input type="checkbox"/> e. HUBZone	<input type="checkbox"/> f. EMERGING SMALL BUSINESS		

13. PLACE OF		14. GOVERNMENT B/L NO.	15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date)	16. DISCOUNT TERMS
a. INSPECTION	b. ACCEPTANCE			

17. SCHEDULE (See reverse for Rejections)

ITEM NO.	SUPPLIES OR SERVICES	QUANTITY ORDERED	UNIT	UNIT PRICE	AMOUNT	QUANTITY ACCEPTED
	Modular Space Vehicle Multi-Mission Modular Bus Development Task Order The Contractor shall furnish all labor, supplies, materials, travel, other direct costs, and fees, necessary to accomplish the requirements contained in the attached Task Order.					

SEE BILLING INSTRUCTIONS ON REVERSE	18. SHIPPING POINT	19. GROSS SHIPPING WEIGHT	20. INVOICE NO.		17(h) TOT. (Cont. pages)	
	21. MAIL INVOICE TO:					
	a. NAME					17(i) GRAND TOTAL
	b. STREET ADDRESS (or P.O. Box)					
c. CITY		d. STATE	e. ZIP CODE			

22. UNITED STATES OF AMERICA BY (Signature)	23. NAME (Typed) Patricia B. Hudson
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1. SUPPLIES/SERVICES TO BE PROVIDED

This is a Task Order, entitled “Multi-Mission Modular Bus Development,” under the basic NASA Contract, TBD, for Modular Space Vehicle (MSV).

ITEM	SUPPLIES/SERVICES	QTY	UNIT	TOTAL COST
01	Develop and Build a Multi-Mission Modular Bus in accordance with the attached SOW.”	1	Job	
02	Space Vehicle AI&T Support and Mission Demonstration	1	Job	
03	Launch and On-orbit Mission Support	1	Job	

(End of Clause)

2. NFS 1852.232-81 CONTRACT FUNDING (JUN 1990)

(a) For purposes of payment of cost, exclusive of fee, in accordance with the Limitation of Funds clause, the total amount allotted by the Government to this contract is \$_____. This allotment is for costs and covers the following estimated period of performance: _____.

(b) An additional amount of \$_____ is obligated under this contract for payment of fee.

SUMMARY OF CONTRACT FUNDING	FROM	BY	TO
Cost	TBD	TBD	TBD
Fixed Fee	TBD	TBD	TBD
Total Cost Plus Fixed Fee	TBD	TBD	TBD

(End of Clause)

3. STATEMENT OF WORK

The Contractor shall furnish all labor, supplies, materials, travel, other direct costs, and fees, necessary to accomplish the requirements contained in Attachment 1, Task Order Statement of Work, entitled "Multi-Mission Modular Bus Development."

(End of Clause)

4. PERIOD OF PERFORMANCE

The period of performance for this task order is as follows:

ITEM	SUPPLIES/SERVICES	QTY	DELIVERY DATE
01	Develop and Build a Multi-Mission Modular Bus in accordance with the attached SOW.	1	24 months
04	Space Vehicle AI&T Support and Mission Demonstration accordance with the attached SOW.	1	6 months (Starts after the complete Space Vehicle is delivered to the RRSW, to include payload)
05	Launch and On-orbit Mission Support in accordance with the attached SOW.	1	18 months (Starts launch - 30 days)

(End of Clause)

ATTACHMENT 1

**ORS MODULAR SPACE VEHICLE (MSV)
MULTI-MISSION MODULAR BUS DEVELOPMENT TASK ORDER
STATEMENT OF WORK**

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STATEMENT OF WORK

Multi-Mission Modular Bus Development

1 Scope

This Statement of Work (SOW) delineates the tasks the contractor will accomplish to manage and execute the technical, schedule and cost performance necessary to meet the Operational Responsive Space (ORS) Multi-Mission Modular Bus mission requirements. The scope of this SOW is intended to include the efforts needed to meet the flight mission demonstration to include: the modular bus flight hardware; integration of modular payload flight hardware; space vehicle integration, test, and validation; flight software; mission launch support; post-launch turn-on; calibration; checkout; and user handoff; and on-orbit support. The contractor will support the Rapid Response Space Works (RRSW) refine Assembly, Integration, & Test (AI&T) processes, documentation, and with the ORS Multi-Mission Modular Bus and Payload mission hardware AI&T exercises; refinement of the modular payload building block interface specifications for multi-mission compatibility; support first-item AI&T of the Space Vehicle and demonstration of a RRSW rapid response from notification to on-orbit operations. This Task Order does not include launch or ground infrastructure development.

1.1 Objective

The objective of this Task Order is to incorporate the modular bus architecture developed by the ORS Office, and Government and industry partners into a hardware development and flight demonstration of a multi-mission Modular Space Vehicle (MSV) mission. The ORS Office has selected this MSV mission to be a stressing mission (capable of supporting a Synthetic Aperture Radar (SAR) payload) that will address the following key ORS Office enabler objectives to include: 1) Demonstration of the end-to-end RRSW response; and 2) Demonstration of an open standards-based, rapidly configurable, multi-mission, modular bus architecture. The specific mission performance, operational user requirements, program requirements and constraints, to be used for this Task Order are documented under a separate document, "Operationally Responsive Space (ORS) Architecture Guidebook", which are referenced in section 2.0. The ORS office has multiple separate developments planned and underway, such as the RRSW rapid AI&T, which will require complimentary interaction and support throughout the execution of this Task Order.

2 Applicable Documents

- Operationally Responsive Space (ORS) Architecture Guidebook
- Tier-2 Enabler (T2E) Mission Government Reference Document

3 Requirements

3.1 Mission Systems Engineering, Analysis, & Design Tool Simulation

3.1.1 Mission Planning & System Engineering Support

The contractor shall support a Government conducted Systems Requirements Review (SRR) that will encompass the entire mission (i.e., all mission component requirements and providers will participate) early in the program at a contractor or Government facility. SRR details are captured in the Systems Engineering Management Plan (SEMP). The envisioned SRR covers

traditional topics; assessment of the overall program plan systems engineering methodology and simulation, bus 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.

The contractor shall perform systems engineering analysis and simulation as required throughout the program to technically guide the overall effort and to generate required technical support analysis for decision making. The contractor shall support the Government Integrated Product Teams (IPT) by providing program technical information, simulation analyses, and in developing the RRSW rapid response mission concept of operations.

The contractor shall support the RRSW contractor and Government with the overall Mission Plan development and execution. The contractor shall generate and deliver the bus section of the Mission Plan, which will be updated to remain current with findings and results throughout the program execution. The mission plan contains the detailed plan for the flight experiment to include: description of operational concept (graphic); specifics on data collection/imaging; areas to be imaged; data processing and analysis plans; and a list of experiments to be executed that are aimed at evaluating and quantifying the space vehicle capabilities and limitations. The contractor shall use the "ORS Architecture Guidebook" as a source for relevant material for systems engineering trades and mission plan document generation.

3.1.2 ORS Rapid Response Demonstration Plan

The contractor shall develop and maintain the MSV Bus portion of RRSW Mission End to End Demonstration Plan. The "ORS Architecture Guidebook" contains a description of the RRSW end-to-end vision. Development of Demonstration Plan involves interaction and support among the separate RRSW and MSV developments. This interactions includes information exchange, participation in AI&T demonstrations, providing recommendations to RRSW on AI&T processes/procedures specifically related to modular buses and supporting RF payloads, and recommendations on depot hardware cell structure and inventory requirements. The content envisioned for the Demonstration Plan includes (but is not limited to); planned AI&T process step time allocations, description of key process steps, and Cost, Size, Weight, and Power (C-SWAP) analysis for each of the hardware and/or software components required for the space vehicle and mission execution, and disassembly, handling, and component storage requirements and processes. The contractor shall maintain close interaction and support with the RRSW team during the development and use of the Demonstration plan. The RRSW contractor will be responsible for tracking and updating the Demonstration Plan throughout the program. The RRSW contractor will incorporate the Demonstration Plan into the development of other relevant plans and procedures (such as pre-launch, post launch turn-on, calibration, etc.).

3.1.3 Mission Design Toolkit

The Mission Design Toolkit (MDT) is a major ORS element to be developed under a separate Task Order for use within the RRSW, and across other MSV contractors, ORS Office, and other Government agencies. The contractor shall identify MDT requirements, constraints, and features to be addressed by the MDT throughout the duration of this task order.

3.2 Multi-Mission Modular Space Vehicle Design & Prototype Validation

3.2.1 Multi-Mission, Modular Space Vehicle Specification & Interface

The baseline multi-mission, modular bus architecture with building block functional allocations, initial specifications and preliminary block interface requirements is defined in the "ORS Architecture Guidebook". The contractor shall complete the bus specifications and define open

interfaces between the modular bus architecture and the other mission components under this task. For each interface, the contractor shall use accepted open interface standards from industry and Government. Chosen interfaces should address both physical and informational interfaces (if applicable) between the modular building blocks. The contractor shall incorporate/consider multi-mission needs so that each interface can be standard across different missions to the greatest extent possible. All ICD specifications and Modular Open System Architecture (MOSA) interfaces are to be non-proprietary.

3.2.2 Hardware Risk Reduction/Verification

The contractor shall use hardware subsystems that meet Technology Readiness Level (TRL) of prototyped hardware or higher (flight qualified or flight proven) in the space vehicle designs. When space vehicle designs incorporate lower TRL levels, the contractor shall conduct Non-Recurring Engineering (NRE)/prototype activities to quantify and reduce the risk of employing that subsystem. The contractor shall implement risk mitigation for items identified as critical high risk that have TRLs less than 7. Risk mitigation may involve the early inclusion of parallel paths for decisions at key development milestones.

3.2.3 Software Risk Reduction/Verification

The contractor shall analyze the mission software determined to be critical high risk and provide quantitative results of the analyses. The initial identification of critical high risk software and mitigation analyses occurs at SRR and will be updated at succeeding design reviews.

3.2.4 Space Vehicle Design

The contractor shall support the RRSW contractor to complete the detailed design of the space vehicle to meet the ORS mission in accordance with the end-to-end demonstration requirements (modular breakdown, interfaces, rapid AI&T, etc.).

The contractor design shall meet launch vehicle requirements, launch integration requirements, and be compatible with mission ground system components. Additionally, the design will be compatible with pre-launch checkout, post launch checkout/turn-on, and calibration.

The contractor shall participate in a space vehicle CDR to enable a multi-disciplined product and process assessment to ensure the ORS mission 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), risk, and other fulfill stated ORS Office objectives.

The contractor shall define a detailed schedule (as determined to be necessary) for the bus portion of the space vehicle CDR. The schedule 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.

3.3 Bus Flight Hardware and Software Build

3.3.1 Bus AI&T Plan

The contractor shall develop, execute, and document a plan for manufacturing the modular bus. The plan shall meet the bus requirements for the ORS mission, and shall include the plan for supporting multi-mission bus modularity design verification and include recommendations for future inventory needs and control requirements for the RRSW rapid AI&T process. In this plan, the contractor shall include the hardware/software subsystem component supplier purchase plan as well as the step-by-step instructions for the assembly, disassembly, and integration and test procedures for the sub-assemblies and bus. The documentation/instructions are required to be sufficient for transitioning to overall space vehicle integration. The contractor shall deliver

the instructions to the Government for future use at the RRSW on the delivered hardware or process refinement for similar hardware.

3.3.2 Bus Sub-system Fabrication & Qualification

The contractor shall manufacture, test, and procure the RRSW Bus inventory to satisfy the ORS mission. The contractor shall minimally include: vendor component procurement; software; subsystem hardware fabrication; and qualification testing.

3.3.3 Bus Assembly, Integration & Verification

The contractor shall integrate the bus sub-system assemblies into a fully functional bus and conduct tests to meet qualification requirements. The contractor shall include a quality assurance/mission assurance function at the appropriate level of rigor and effort so as to achieve the desired performance and schedule goals.

3.3.4 Multi-Mission Bus Compatibility Demonstration

The contractor shall demonstrate through analysis or experimentation the multi-mission bus design aspects of the plan. Multi-mission demonstrations may include scalable power, LEO & HEO capability, compatibility with EO and RF payload modes of operation.

3.4 Payload Flight Hardware and Software Build

Section not used.

3.5 Space Vehicle Integration & RRSW Support

3.5.1 Space Vehicle AI&T Plan

3.5.1.1 The contractor shall support development of the RRSW plan for AI&T of the bus and payload into the final space vehicle. This plan will incorporate the instructions delivered from the MSV contractor for bus and generic payload into a full space vehicle set of instructions. The plan for AI&T will contain the step-by-step instructions for space vehicle assembly, disassembly, integration and test.

3.5.1.2 The contractor shall develop, maintain, and publish a Requirements Verification Matrix (RVM) for the bus in the AI&T plan.

3.5.1.3 The contractor shall support the RRSW integrating the bus RVM into the space vehicle RVM.

3.5.1.4 The contractor shall provide sufficient verification documentation for proceeding to launch integration.

3.5.1.5 The contractor shall support development of a plan to incorporate the bus hardware, software, plans, procedures, documentation, and lessons learned into the RRSW assets.

3.5.2 Space Vehicle AI&T

The contractor shall participate with the RRSW contractor at the RRSW to assemble the bus and payload together into an integrated space vehicle using the space vehicle AI&T plan followed by the testing and validation of the space vehicle.

3.5.3 Shipping Container

3.5.3.1 The contractor shall design and develop a reusable bus shipping container compatible with launch site requirements.

3.5.3.2 The shipping container design shall accommodate all mission package requirements such as purge, shock, and contamination.

3.5.3.3 The contractor shall package the bus as required for shipment to the RRSW and/or launch site as directed.

3.5.4 RRSW Support

The contractor shall provide support to the RRSW facility for space vehicle AI&T demonstrations and bus verification following shipment to the launch site.

3.6 Launch Campaign & Mission Support

3.6.1 Launch Vehicle Integration Support

3.6.1.1 The contractor shall identify bus unique launch issues and develop their solutions in accordance with launch vehicle integration procedures.

3.6.1.2 The contractor shall support the Government team for launch vehicle integration. Support is defined as technical advice and troubleshooting integration difficulties.

3.6.2 Pre-Launch Checkout

The contractor shall support the definition, development and execution of the RRSW mission pre-launch processes and procedures required to obtain a go-for-launch decision. Pre-launch check out procedures shall be developed in accordance with the rapid time to launch goals.

3.6.3 Post-Launch Turn-on/Checkout/Calibration

The contractor shall define and document the bus turn-on procedures via a step-by-step process that is required to be followed for space vehicle checkout. The checkout process shall include bus calibration procedures.

3.6.4 Flight Software

The contractor shall support space vehicle turn-on, checkout, and calibration. The contractor shall develop the required software for executing the turn-on, checkout and calibration procedures.

3.6.5 Ground Infrastructure Compatibility

The contractor shall maintain compliance with the ground system infrastructure for flight control and data downlink.

3.6.6 Mission On-Orbit Anomaly Support

The contractor shall provide on-orbit anomaly resolution support to the Government on an as-needed basis.

4 Programmatic Tasks

4.1 Design Reviews

The contractor shall conduct a bus PDR and CDR.

4.2 Design Review Support

The contractor will support reviews conducted at Government facilities, other MSV and RRSW contractors' facilities, the launch site, and the Satellite Operations Center (SOC). Anticipated reviews include Payload and Mission reviews, System Requirements Review (SRR), Test Readiness Review (TRR), Mission Readiness Review (MRR), Spacecraft Pre-Ship Review (S-PSR), and Launch Readiness Review (LRR).

4.3 Technical Interchange Meetings

The contractor shall conduct and/or support Technical Interchange Meetings with the Government, payload contractor, RRSW contractors and potential ground segment providers as needed to identify, resolve, and establish architecture, technical interface, assembly, and integration activities/direction.

4.4 Customer Communications

The contractor shall maintain proactive, open and responsive communication with the Government.

4.5 Cost Performance

The contractor shall establish a program cost baseline to measure cost progress. Control account cost progress shall be measured monthly. When an individual control account experiences a negative cost variance exceeding ten percent, the contractor shall advise the Government of variance and provide a resolution plan.

4.6 Contractor Integrated Performance Management

The contractor shall establish, maintain, and use in the performance of this contract, an integrated performance management system. Central to this integrated system shall be an Earned Value Management System (EVMS) in accordance with NASA Federal Acquisition Regulation Supplement (NFS) 1852.234-1, NFS 1852.234-2, and the EVMS guidelines contained in ANSI/EIA-748 (<http://guidebook.dcmamail.com/79/EVMIG.doc>). To establish the integrated performance management system, the EVMS shall be linked to and supported by the contractor's management processes and systems to include the integrated master schedule, contract work breakdown structure, change management, material management, procurement, cost estimating, and accounting. 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.

4.7 Integrated Master Schedule (IMS)

The contractor shall develop and maintain a bus Integrated Master Schedule (IMS) by logically networking detailed program activities. This will flow into an overarching IMS. The contractor shall develop the schedule to contain the planned events and milestones, accomplishments, exit criteria, and activities from contract award to the completion of the contract. The contractor shall quantify risk in hours, days, or weeks of delay and provide optimistic, pessimistic, and most likely duration for each IMS activity and event.

4.8 Integrated Baseline Reviews (IBRs)

The contractor shall engage jointly with the Government's program manager in Integrated Baseline Reviews (IBRs) to evaluate the risks inherent in the contract's planned performance measurement baseline. Initially, this shall occur as soon as feasible but not later than six months after contract award, and subsequently following all major changes to the baseline. Each IBR should verify that the contractor is using a reliable performance measurement baseline, which includes the entire contract scope of work, is consistent with contract schedule requirements, and has adequate resources assigned. Each IBR should also record any indications that effective Earned Value Management (EVM) is not being used. IBRs should also be conducted on subcontracts that meet or exceed the EVM application threshold. The prime contractor shall lead the subcontractor IBRs, with active participation by the Government. (See NFS 1852.234-2)

4.9 Risk Management

The contractor shall identify program risks and individual mitigation plans to retire risks as defined in the Risk Management Section of the System Engineering Management Plan (SEMP). The contractor shall assess program risks on an ongoing basis and evaluate risk mitigation progress monthly.

4.10 Quality Assurance

The contractor shall develop and accomplish quality assurance in accordance with the Quality Assurance Section of the SEMP.

4.11 Work Breakdown Structure (WBS)

The contractor shall develop and maintain a contractor WBS for the Multi-mission Modular Bus.

5 Deliverables

5.1 Period of Performance

The period of performance for this effort is anticipated as 48 months from the effective date of this task order. The mission launch goal is 30 months from contract award.” The contractor shall deliver the following items or services as described below.

5.1.1 Multi-mission Modular Bus

Deliver bus and support equipment to the RRSW facility which is anticipated as 24 months from approval to proceed. This includes: bus hardware and baseline version of software, special handling interface, and/or test equipment for payload, special adaptors, engineering unit hardware/software, and other fixtures.

5.1.2 Space Vehicle AI&T Support and Mission Demonstration

Three months, starting from delivery of complete Space Vehicle, including payload, of support is anticipated for AI&T at the RRSW to establish Government acceptance of the bus hardware and software (to include delivery of updated versions of software) based on results of space vehicle testing. In addition, three months of support is anticipated for RRSW mission demonstration.

5.1.3 Launch and On-orbit Mission Support

Eighteen months of on-orbit support to include 90 days of early on-orbit support for system checkout and as required, reach-back support for anomaly resolution.

5.2 Documentation

The contractor shall deliver the documentation in accordance with the following Data Requirements List:

Report Number	Report Title	Report Number	Report Title
015	Program Plan	019	System/Subsystem Specification
016	Contract Performance Report (CPR)	020	Analysis, Test, Inspection and Demonstration Plan and Verification Summary
017	Cost Data Summary Report (CDSR)	021	Software Product Specification
018	System Engineering Management Plan (SEMP)	022	Space Vehicle Handbook (SVH)

6 Cost Estimate

The Government estimates that a first article multi-mission bus that is capable of meeting a SAR payload mission would cost between \$25M and \$35M (see ORS architecture Guide Book) and be on a path to meet a recurring space vehicle cost of \$40M consistent with the ORS Office's 2015 end-state vision.