

STATEMENT OF WORK

"Flight Services for Descent and Landing Testbed Vehicles"

1. BACKGROUND

The NASA Space Technology Mission Directorate (STMD) Flight Opportunities Program (hereafter "the Program") works towards maturing the flight readiness of crosscutting technologies that advance multiple future space missions. The Program acquires commercial flight and payload integration services to fly technology payloads on missions to help achieve the goals of the STMD. A specific component of this effort is the testing of innovative technologies that require flight on propulsively controlled vertical landing rockets, including closed-loop flight with the payload in the guidance, navigation, and control loop of the vehicle. This requirement was not initially anticipated by the Program but has subsequently received interest for testing technologies for use during the entry, decent, and landing phase of a space mission and other applications. To meet the objectives for testing these technologies, the Program intends to acquire flight services on vehicles that mimic the relevant environment needed for these new testing requirements. The relevant environment specifically sought in this solicitation is flight on board, and in control of, a propulsively controlled rocket during hovering, cross range and down range translation, and vertical landing maneuvers. Technology payloads are being solicited under a separate Announcement of Flight Opportunities issued by the Program.

2. OBJECTIVES

The Program intends to acquire commercial flight services to fly technology payloads on propulsively controlled vertical landing rockets that accommodate both open-loop flight and closed-loop flight with the payload in the guidance, navigation, and control loop of the vehicle.

3. SCOPE

The government expects to award contracts to one or more vendors who have a demonstrated capability to provide regular, commercial open-loop and closed-loop flight services for technology payloads. NASA will award each successful vendor an indefinite delivery/indefinite quantity (IDIQ) contract, with the opportunity to propose on Firm Fixed Price Task Order Requests issued by NASA to fly payloads. Each Task Order will be an order to fulfill the requirements of the NASA-provided Mission Requirements Document (MRD) for a given Program-sponsored payload or set of Program-sponsored payloads. The MRD establishes the payload operational requirements, mission performance requirements, data delivery requirements, payload access requirements, and the mission exit criteria. The MRD will be issued to the vendor(s) as part of each Task Order Request and may contain requirements for flying one or more payloads on one or more flights. It is anticipated that the Program will issue multiple Task Order Requests to the vendors during the period of performance of the contract. Each vendor awarded a Task Order will supply both flight and payload integration services in accordance with the requirements identified in the Task Order. The Task Order will be awarded at the firm fixed price indicated in the contract's Price List for Standard and Non-Standard Services. Vendors will be paid in accordance with the contract's Milestones payments clause.

4. REQUIREMENTS

4.1. Flight Vehicle Requirements

To successfully deliver the relevant spacecraft-like systems and flight environment needed to test technologies related to the landing phase of a space mission or similar flight profile, a “Qualified Vehicle” meets the following requirements:

- 4.1.1. **The flight vehicle(s) shall be propulsively controlled.** “Propulsively controlled” is defined to mean the primary method for maneuvering the vehicle is the vectoring or modulation of thrust from rocket and/or maneuvering thruster systems.
- 4.1.2. **The flight vehicle(s) shall be capable of a rocket powered vertical landing within one meter of the intended landing point.**
- 4.1.3. **The flight vehicle(s) shall be at least 50% reusable by mass, excluding consumables such as fuel.**
- 4.1.4. **The flight vehicle(s) shall be capable of carrying a minimum of 1kg, accommodating a minimum volume of 1U CubeSat, travelling a minimum of 100m above ground level in altitude, and traveling a minimum of 50m downrange.**

4.2. General Requirements

- 4.2.1. **The vendor shall have demonstrated commercial capability for open-loop flights with a Qualified Vehicle.** “Open-loop flight” is defined as a free flight in which a third party payload or third party control algorithm is integrated on board the vehicle and active, but is not part of the guidance, navigation, and control (GN&C) loop of the vehicle. The payload may, or may not, require input from the GN&C system. Individual task order shall address GN&C requirements.
- 4.2.2. **The vendor shall have demonstrated commercial capability for closed-loop flights with a Qualified Vehicle.** “Closed-loop flight” is defined as a free flight in which a third party payload or third party control algorithm is an integral part of the guidance, navigation, and control loop of the vehicle.
- 4.2.3. **The vendor shall offer commercial flight operations.** “Commercial” shall be interpreted to mean that successful vendors operate independently from the government. All end items provided under this contract, including (but not limited to) payload space(s) on Qualified Vehicles, vehicle components, subsystems, ground support facilities, and contracted services shall not be government provided, owned, or operated. The vendor shall be solely responsible for obtaining appropriate licensing, waivers, and/or flight approvals. The vendor shall be solely responsible for ground and flight Safety, Mission Assurance, and Environmental compliance in accordance with local, state, and Federal regulations. The vendor will provide all Qualified Vehicles systems engineering, payload integration, and any other required services. The vendor may propose the use of certain unique government-owned ground and range facilities on a fully-reimbursable basis, but in no way shall that release the vendor from full responsibility for

all aspects of flight and ground operations. All such arrangements shall be the sole responsibility of the vendor.

- 4.2.4. The vendor shall provide government observers access to contractor facilities as required on non-interference, ad hoc basis.**
- 4.2.5. The vendor shall provide a Payload User's Guide to be made available to Payload Providers three weeks after contract award.** The "Payload User's Guide" is the documentation that defines the payload interfaces of the Qualified Vehicle, including, but not limited to: mechanical, electrical, communication, information/data, and environmental interfaces.
- 4.2.6. The vendor shall develop a Mission Implementation Document (MID) in response to Task Order Requests to which the Contractor chooses to respond.** The "Mission Implementation Document (MID)" is defined as the document that establishes the agreement between the Payload Provider, the vendor, and the Program as to how the requirements of an MRD will be implemented, including any deviations.
- 4.2.7. The vendor shall accept a payload that meets the requirements of the MID for integration and flight.** The Payload Provider will conduct a Payload Readiness Review with the vendor prior to delivery of the payload. The vendor can refuse to accept any payload that does not meet the requirements of the MID.
- 4.2.8. The vendor shall perform a system safety analysis of the payload integration and flight operation and make it available to the government.** Depending on criticality and cost of the payload, the Program may conduct a Mission Risk Assessment (MRA) prior to flight. In that event, the vendor is encouraged to participate in the MRA and assist the government with its assessment.

4.3. Flight Requirements

- 4.3.1. The vendor shall be responsible for the flight operations, which includes provision of the flight range, operational facilities, and all required personnel.**
- 4.3.2. The vendor shall obtain approval or waivers for operation, as applicable, from the Federal Aviation Administration (FAA) or other governing authority for the flight activity. The Contractor shall provide NASA with written evidence of any required licenses, approvals, or waivers.**
- 4.3.3. The vendor shall provide a flight service that meets the requirements of the MID.**
- 4.3.4. The vendor shall return the payload to the Payload Provider in the condition in which it was received, less consumables and normal wear-and-tear.**
- 4.3.5. The vendor shall provide the Payload Provider access to the payload within three hours prior to, and no more than three hours post hazardous operations.**

- 4.3.6.** The vendor shall not make public statements regarding activities conducted under this contract without prior coordination of such announcement. Public announcements shall be submitted by the vendor in advance of publication to the NASA Public Affairs designee for review and approval.
- 4.3.7. The vendor shall be capable of flying a given payload more than once within five consecutive calendar days.**
- 4.3.8. The vendor shall provide a successful flight.** A “successful flight” is defined as a flight that has fully and safely met the requirements of section 4.2, 4.3, and the Task Order.
- 4.3.9.** If it is determined by NASA that negligence or undue delay on behalf of the Payload Provider has caused the delay of a scheduled flight, NASA will pay the Vendor for a period not to exceed 5 days per task order, or the remaining value of the task order, whichever is less. Delays caused by the launch facility, regulation, inclement weather, NASA, the FAA or other Government agencies, or other situations beyond the control of NASA or the Payload Provider shall not be charged.

4.4. Payload Integration Requirements

- 4.4.1. The vendor shall manage an interface control document (ICD) between the payload and the flight vehicle.**
- 4.4.2. The vendor shall integrate the payload into the flight vehicle system.**
- 4.4.3. The vendor shall integrate the payload operation, including telemetry and command, into the flight operation.**
- 4.4.4. The vendor shall provide and operate the appropriate payload facilities and payload support equipment for the payload integration activity.**
- 4.4.5. The vendor shall verify that the payload, as integrated and while operating, is compatible with the vehicle systems and any other payloads.**
- 4.4.6. The vendor shall provide a successful integration.** A “successful integration” is defined as meeting the requirements of section 4.2, 4.4, and the requirements of the Task Order.

5. Deliverables

- 5.1. The vendor shall provide a Payload User’s Guide (SOW 4.2.5) for each Qualified Vehicle (due 3 weeks after contract award).**
- 5.2. The vendor shall develop and deliver a Mission Implementation Document (MID) in response to Task Order Requests to which the Contractor chooses to respond (SOW 4.2.6).**
- 5.3. The vendor shall deliver items and services required in an awarded Task Order.**
- 5.4. The vendor shall deliver a Flight Data Report (within one (01) week of flight completion unless otherwise specified in the Task Order). The “Flight Data**

Report” is defined as a summary of the flight operation as related to the requirements of the MID and the Task Order. The Flight Data Report includes formatted data item deliverables as specified in the Task Order.

6. DEFINITIONS

Closed-loop Flight is defined as a free flight in which a third party payload or third party control algorithm is an integral part of the guidance, navigation, and control loop of the vehicle. This includes, but is not limited to, the payload actively and autonomously commanding the speed, position, and orientation of the flight vehicle.

Commercial shall be interpreted to mean that successful vendors operate independently from the government. All end items provided under this contract, including (but not limited to) payload space(s) on Qualified Vehicles, vehicle components, subsystems, ground support facilities, and contracted services shall not be government provided, owned, or operated. The vendor shall be solely responsible for obtaining appropriate licensing, waivers, and/or flight approvals. The vendor shall be solely responsible for ground and flight Safety, Mission Assurance, and Environmental compliance in accordance with local, state, and Federal regulations. The vendor will provide all Qualified Vehicles systems engineering, payload integration, and any other required services. The vendor may propose the use of certain unique government-owned ground and range facilities on a fully-reimbursable basis, but in no way shall that release the vendor from full responsibility for all aspects of flight and ground operations. All such arrangements shall be the sole responsibility of the vendor.

Demonstrated shall be interpreted to mean that successful vendors have conducted flights that would meet the requirements of 4.2.1- 4.2.3, 4.3.1, 4.3.2, 4.3.4, 4.3.5, and section 4.4 with a Qualified Vehicle.

Flight Data Report is defined as a summary of the flight operation as related to the requirements of the MID and the Task Order. The Flight Data Report includes formatted data item deliverables as specified in the Task Order.

Mission Implementation Document (MID) is defined as the document that establishes the agreement between the Payload Provider, the vendor, and the Program as to how the requirements of an MRD will be implemented, including any deviations.

Mission Requirements Document (MRD) is defined as the NASA-provided document that establishes the payload operational requirements, mission performance requirements, data delivery requirements, payload access requirements, and the mission exit criteria; the MRD is agreed upon by the Payload Provider and the Program. The MRD will be issued to the vendor(s) as part of a Task Order Request.

Open-loop Flight is defined as a free flight in which a third party payload or third party control algorithm is integrated on board the vehicle and is active, but is not part of the guidance, navigation, and control loop of the vehicle.

Payload User’s Guide is the vendor-provided documentation that defines the payload interfaces of the Qualified Vehicle, including, but not limited to: mechanical, electrical, communication, information/data, and environmental interfaces.

Propulsively controlled is defined to mean the primary method for maneuvering the flight vehicle is the vectoring or modulation of thrust from rocket and/or maneuvering thruster systems (as opposed to aerodynamic surfaces or other mechanisms for steering the vehicle).

Qualified Vehicle is defined as a flight vehicle that meets the requirements of section 4.1

Task Order is defined as an order issued by the NASA Contracting Officer to the vendor(s), written under the terms and conditions of the contract, to fulfill the requirements of an MID for a given payload or payloads.

7. Price List for Standard and Non-Standard Services – Offeror to Complete

Standard Flights (see description below) for proposed Qualified Vehicle:

Item	Description	Firm Fixed Price
001	Reservation of test, successful payload integration, and successful execution of a Tethered Test	
002	Reservation of flight, successful payload integration, successful flight, and delivery of Flight Data Report for an Open-loop Flight	
003	Reservation of payload, successful payload integration, successful flight, and delivery of Flight Data Report for a Closed-loop Flight	

Non-standard Services (Labor): (see description below)

004	Labor Category (offeror to complete each category as necessary)	Fixed Hourly Rate (fully burdened rate)

Non-standard Services (Materials): (see description below)

005	Material Handling Charge for non-standard services	% (To be Proposed)

006	Delays	Firm Fixed Price per Day
	Amount to be paid, per day, if determined by NASA that negligence or undue delay on behalf of the Payload Provider has caused the delay of a scheduled flight, not to exceed 5 days per task order, or the remaining value of the task order, whichever is less. Delays caused by the launch facility, regulation, inclement weather, NASA, the FAA or other Government agencies, or other situations beyond the control of NASA or the Payload Provider shall not be charged.	
007	Other Categories of Services/ Supplies proposed by Offeror (not included in Items 01 – 06 above)	Firm Fixed Price (To be Proposed)

Services and Items proposed in Item 007 above will be considered for inclusion in any resulting contract; however, the price will not be included in the comparison of prices with other offers.

Standard Flight Services

The vendor shall provide payload integration and flight services for various experimental payloads on Qualified Vehicles. Payload, integration, and flight requirements will be further defined by issuance of fixed-price task orders from the government, which shall be all-inclusive for a particular individual mission requirement. For the purposes of this contract, “Standard Flight” shall mean the services the vendor expects to provide on a commercial basis to any customer with flight requirements.

The vendor shall provide firm fixed pricing for their standard payload, specifying volume, mass, and interfaces (electrical, cooling, control, RF, etc.) and flight profile to be provided for this standard price. Price shall be fully inclusive of all standard services, including payload integration, preflight services, and postflight recovery.

Non-Standard Services

Non-standard services include services above and beyond the vendor’s standard service offering that are required to meet the government’s requirements. When the vendor develops a firm-fixed price response to a Task Order Request, the non-standard services if any, including fixed price fully burdened labor rates,

shall be quoted in conjunction with the firm-fixed price for standard services. In no case will non-standard services be quoted without a quote for standard services.

Example, Non-Standard Services: The government has a payload with 10 antennas. The vendor allows for the integration of 1 antenna as part of the vendor’s standard service delivery. The vendor will quote the price for standard services and quote the price for integration of the other 9 antennas (non-standard service/ labor and materials) to meet the government’s requirement.

Non-standard services include any task request that does not fall within the vendor’s standard service offering.

8. Milestone Payments: Offeror to Propose

The Offeror shall limit its proposed milestone payments for each task order to the following percentage ranges for each different flight level to establish the task order distribution amount to be paid upon successful completion of the milestone. The high end of the range for Milestone 1 may not exceed 30% regardless of the flight level. Milestone 3 shall not be less than 30%. Milestone 4 shall be fixed at 10%.

ITEM 001	Description – Tethered Test	Tethered Test (offeror to propose)
Milestone 1	Reservation of test	Not to exceed 30%
Milestone 2	Successful payload integration	%
Milestone 3	Successful execution of a Tethered Test	Not less than 30%
Total		100%

ITEM 002	Description – Open Loop Flight	Flight (open-looped)
Milestone 1	Reservation of a slot for payload	Not to exceed 30%
Milestone 2	Successful payload integration	%
Milestone 3	Successful flight	Not less than 30%
Milestone 4	Delivery of the Flight Data Report	10%
Total		100%

ITEM 003	Description – Closed-Loop Flight	Flight (closed-loop)
Milestone 1	Reservation of a slot for payload	Not to exceed 30%
Milestone 2	Successful payload integration	%
Milestone 3	Successful flight	Not less than 30%
Milestone 4	Delivery of the Flight Data Report	10%
Total		100%