

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. Each successful vendor will receive an indefinite delivery/indefinite quantity (IDIQ) contract, with the opportunity to propose on Firm Fixed Price Task Orders issued by the Program to fly payloads. Each Task Order will be a request from the Program to the vendor to fulfill the requirements of the 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 a Task Order solicitation that may contain requirements for flying one or more payloads on one or more flights. It is anticipated that the Program will issue multiple Task Orders 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.

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 loop of the vehicle.
- 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.** 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 solicitations 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 be capable of flying a given payload more than once within five consecutive calendar days.**

4.3.7. 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.

4.4. 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 for each Qualified Vehicle.**
- 5.2. The vendor shall deliver a Mission Implementation Document (MID).**
- 5.3. The vendor shall deliver items required in an awarded Task Order.**
- 5.4. The vendor shall deliver a Flight Data Report.** 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 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 solicitation.

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 a request from the Program to the vendor(s) to fulfill the requirements of an MID for a given payload or payloads.