

**Introduction**

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) invites industry to submit a response to this Request for Information (RFI) to assist NASA in the acquisition planning for the production and operations requirements of the Orion spacecraft. Industry responses to this RFI are requested within the context of the requirements and general approach described in the following sections.

**Orion Program Background**

The Orion spacecraft, also known as the Multi-Purpose Crew Vehicle (Orion), is the spacecraft that will serve as the exploration vehicle that will carry crew to space, provide emergency abort capability, sustain the crew during the space travel, and provide safe re-entry from deep space return velocities.

The Orion spacecraft is an element of the overall Exploration Systems Development (ESD) architecture that includes launch vehicles, spacecraft, mission systems and ground systems, as well as future in-space and surface systems, needed to embark on a robust human solar system exploration program.

Orion will launch on NASA's Space Launch System (SLS). Exploration Mission-1 (EM-1) will be the first mission to integrate Orion and the SLS, and will perform an un-crewed lunar orbit demonstration and high-energy reentry in 2018. Exploration Mission-2 (EM-2) is currently planned for 2021 and will perform a crewed high lunar orbit. ESD is currently performing studies to define follow-on Orion/SLS missions each year starting as early as 2022 to support the "Journey to Mars" objectives of the agency.

NASA is now exploring acquisition strategies to support fulfilling Orion Program requirements beyond EM-2.

**Current Contract Requirements**

NASA's current Orion contract with Lockheed Martin Corporation, NNJ06TA25C, requires the Design, Development, Test, and Evaluation (DDT&E), production, and operations of the Orion Spacecraft System to meet the mission requirements through EM-2.

The Orion contract is a cost-plus hybrid contract with Completion Form, Firm-Fixed-Price, and Indefinite-Delivery, Indefinite-Quantity (IDIQ) orders for special studies and spares. The Orion contract's incentive structure is End Item Award Fee.

The Orion contractor is required to deliver the Orion spacecraft configurations below per requirements in the MPCV-72000, Orion MPCV System Requirements Document (SRD).

The following describes the test flight missions, which the Orion Spacecraft will initially fly:

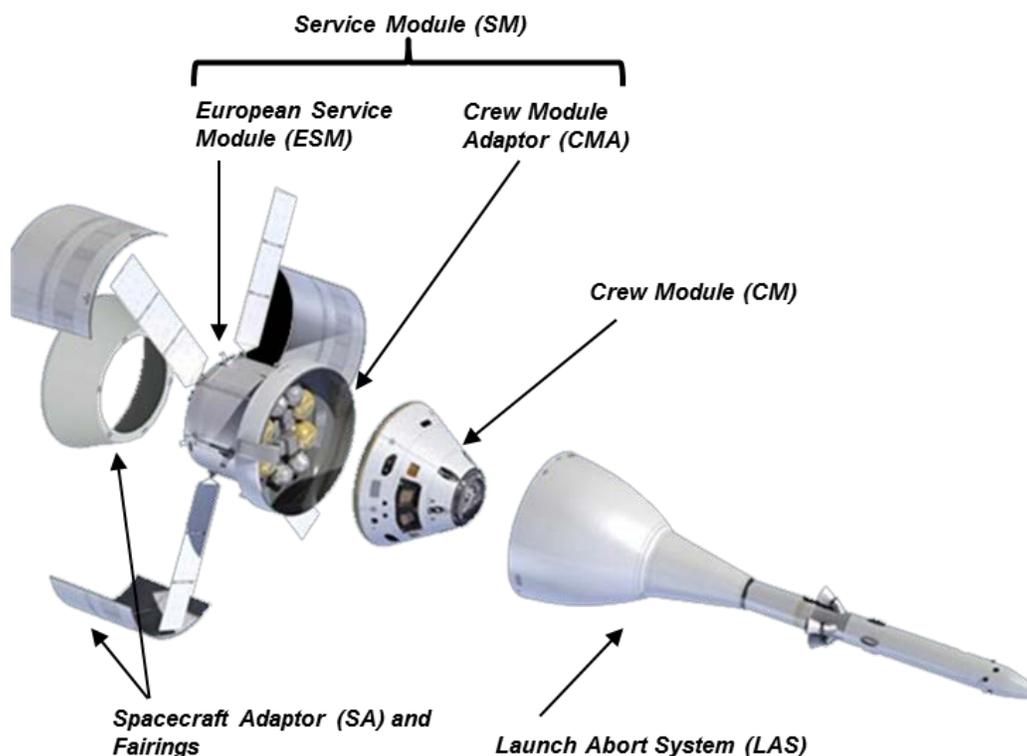
- Exploration Flight Test-1 (EFT-1): Configuration that supports an un-crewed Earth orbit test flight to demonstrate critical systems and high speed re-entry.

- EM-1: Configuration that supports un-crewed Distant Retrograde Orbit (DRO) with free return trajectory and high speed entry, with a mission duration of approximately 25 days, to demonstrate integrated spacecraft systems performance prior to crewed flight.
- EM-2: Configuration that supports crewed lunar orbit mission with a mission duration of approximately 10-14 days, to demonstrate crewed flight beyond Low Earth Orbit (LEO).

The EM-2 configuration of the Orion spacecraft represents the base-vehicle capable of crewed Beyond LEO exploration missions; this will be the “base vehicle” configuration to be produced under this contemplated acquisition. This acquisition will also accommodate selected mission-unique capability augmentations as needed to support the objectives of future defined missions. The following is a summary of the Orion vehicle capability:

The EM-2 configuration includes:

- A Crew Module (CM),
- A Service Module (SM) which includes:
  - o Crew Module Adapter (CMA)
  - o European Service Module (ESM)
  - o Spacecraft Adapter (SA)
  - o Spacecraft Adapter Jettison (SAJ) Fairings
- A Launch Abort System (LAS) to provide a method for crew abort



**CM Element:** The CM is the habitable volume of the Orion spacecraft and functions as the command, control, communications, and navigation center for all in-space operations. The CM is sized to support up to 4 crewmembers for Earth launch and reentry, and for in-space operations per the specific mission design. The CM can also operate in quiescent mode without crew for extended periods in support of mission objectives. The CM is supported by the SM systems and resources for most of the mission, but functions independently during Earth re-entry.

**SM Element:** The SM provides attitude control and propulsion for various maneuvers including rendezvous, Trajectory Correction Maneuvers (TCMs), de-orbit from LEO, and trans-Earth injection from beyond LEO missions. It also provides CM active thermal control support, communications support, passive thermal control, CM Environmental Control and Life Support (ECLS) consumables storage, power generation and energy storage. The SM has fairing panels that protect sensitive SM components during the early ascent phase of flight, which are jettisoned during ascent. The SM is comprised of the ESM, CMA, SA, and SAJ.

**SA Element:** The SA is the physical, structural, and mechanical interface between the Orion Spacecraft and the SLS launch vehicle. It is designed to be compatible with ground operations events, such as transportation and tanking, as well as withstand the complex integrated Orion MPCV-launch vehicle loads and dynamic events induced during launch. The SA carries the command and data interfaces between the Orion MPCV and the launch vehicle.

**LAS Element:** The LAS provides the propulsive impulse to separate the CM from the SM and launch vehicle during a ground or ascent emergency. The LAS consists of a nose cone; three propulsive motors, which are the attitude control, jettison, and abort motors; and a shroud that provides aerodynamic and thermal protection to the CM during nominal ascent and aborts. The LAS is armed by ground command. Nominal arming occurs after crew ingress and after the crew access arm has been retracted during pre-launch operations. The LAS remains available for aborts from this point until second-stage flight, after which it is jettisoned. After LAS jettison, the SM provides abort capability for the remainder of ascent to orbit.

### **Contemplated Future Requirements**

NASA JSC is considering acquisition strategies to enable initial production and operations of the EM-3 (and subsequent) Orion spacecraft concurrent with completion of EM-2. The contemplated future requirements are anticipated to include “build-to-print” production, sustaining engineering, and flight operations support, with limited DDT&E to allow mission kit development as unique mission objectives are defined.

NASA anticipates the production and operations requirements would be met through the reproduction of the Orion spacecraft developed under the current Orion contract based on NASA-provided data such as:

- Interface Control Documents (ICDs)
- Interface Requirements Documents (IRDs)

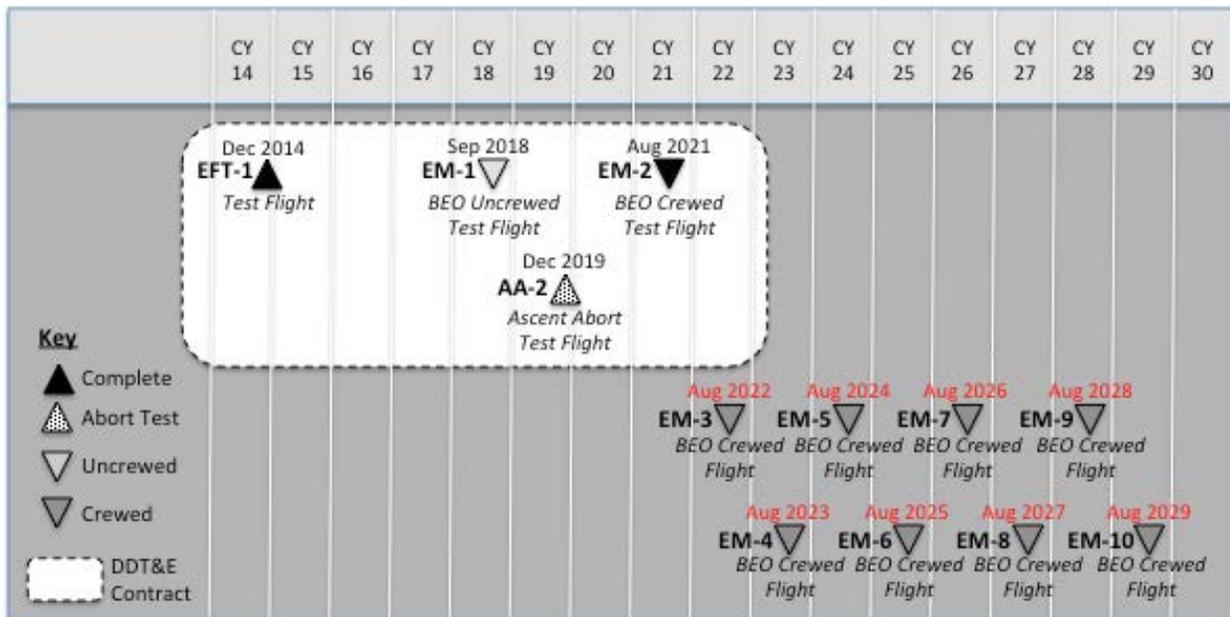
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- Specifications
- Drawings/Computer-aided Drafting (CAD) Models
- System Requirements Documents (SRDs)
- Con Ops Plans

The contemplated acquisition would require the contractor to provide the flight elements (CM, CMA, SA, SAJ, and LAS); Flight Software; Simulation hardware and Ground Support Equipment (GSE); as well as capabilities such as integrated software and avionics testing. It is assumed that the ESM will be government-provided through a partnership with the European Space Agency (ESA) and the contractor for the contemplated acquisition would be required to provide integration support for government-provided hardware such as the ESM and between the SLS Program and the Ground Systems Design Operations (GSDO) Program.

The Orion production and operations requirements are currently contemplated to require production of the first Orion spacecraft under the contemplated future acquisition in time to support a notional launch date of EM-3 in August of 2022, and a subsequent notional launch rate of one launch per year. The period of performance for the contemplated acquisition has not yet been determined. However, the Government anticipates there to be a potential 18-36 month overlap in the periods of performance of the current Orion contract finishing EM-2 and the contemplated Orion production and operations contract performing initial production operations on EM-3. For reference, a notional manifest schedule is provided below which shows a notional schedule of one Orion flight per year through Fiscal Year (FY) 2030.



The following Government Facilities are utilized under the current Orion contract and are anticipated to be made available under the contemplated Orion production and operations acquisition:

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- Operations and Check-Out Facility at the Kennedy Space Center
  - CM Assembly, SM Assembly, CM/SM Integration and Checkout, CMA Assembly
- Launch Abort System Facility (LASF) at Kennedy Space Center
  - LAS Assembly, Integration & Test; LAS Integration with CM/SM (support to GSDO)
- Michoud Assembly Facility located in New Orleans, LA
  - CM Pressure Vessel manufacture, CMA composite panel manufacture

The contractor for the contemplated Orion Production and Operations contract would be expected to provide any and all other facilities required to meet the contract requirements. Examples of facilities currently provided by the contractor for performance of the current Orion contract include: Integrated Avionics and Software Test Laboratory, software development facilities, heat shield manufacturing facilities, and large composite structure manufacturing facilities.

Government Property is also anticipated to be made available under the contemplated Orion production and operations acquisition to support assembly, integration, and testing of the Orion spacecraft on a non-interference basis with ongoing Orion EM-2 related production and testing work. Details regarding the specific Government Property to be provided would be included in a potential solicitation for the contemplated Orion production and operations acquisition.

**Requested Response Topics**

The specific objective of this RFI is to solicit information that may potentially enhance NASA's planned approach for the production and operations of the Orion spacecraft and assist in developing the acquisition strategy.

Comments are requested, but are not limited, to the following topics:

- Expression of your organization's interest in the Orion Production and Operations requirements, which would require reproducing the Orion spacecraft developed under the current Orion contract based on NASA-provided data.
  - If your organization is not interested in competing for this requirement, NASA welcomes a stand-alone response expressing why not.
- Identification of any perceived barriers to competition, and any suggested mitigations, assuming NASA's intent to require the production of multiple units of the Orion spacecraft developed under the current Orion contract.
- It is contemplated that this effort will utilize, to the greatest extent possible, Firm-Fixed-Price contracting. However, suggestions for contract type(s), incentive structure(s), and ordering strategy (e.g. block buy ordering vs. single unit ordering) for the contemplated Orion Production and Operations acquisition that would properly balance risk, reward excellent performance, and reliably reduce unit cost and production schedule duration are

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welcome. Please include any suggested time-phasing approaches, as applicable, for the suggested contract type and incentive structure.

- NASA is interested in your input with regards to the use of a possible hybrid Fixed Price and Cost Reimbursement contractual arrangement to allow industry to obtain a higher return on investment for achieving cost savings while meeting performance requirements. NASA requests any input regarding incentive arrangements to include previous experiences that have been successful in achieving consistently low production cost and predictable schedule, as well as any non-traditional ideas on contract types and incentives.
- Feasibility of the requirement for the production for the first Orion spacecraft unit under the contemplated future acquisition to be complete in time to support a notional launch date of EM-3 in August 2022, and a subsequent notional launch rate of one launch per year
  - Feasibility of the production schedule requirements if the notional launch date for EM-3 were moved to August 2023
- Identification of the contract phase-in/transition risks from an industry perspective and identification of any Government actions that would be required to facilitate an effective transition without delaying the notional EM-3 launch date of August 2022

If a respondent wishes to provide a broader input beyond the topics described in this RFI or beyond the technical scope of the Orion spacecraft, then it is requested alternate responses be submitted separately. However, if a respondent includes an alternate approach other than the reproduction of the Orion spacecraft developed under the current Orion contract based on NASA-provided data, the respondent shall identify which, if any, of the requirements and objectives identified in the “Contemplated Future Requirements” section of this RFI could not be met or would need to be revised to accommodate the alternate approach. The respondent should also identify the cost implications, both impacts and savings, associated with the suggested changes to those requirements.

**Response Instructions**

Please see the RFI posted to the Government Point of Entry (FedBizOpps), to which this document is attached, for complete instructions for submitting a response to this RFI.