National Aeronautics and Space Administration

NASA Advisory Committee

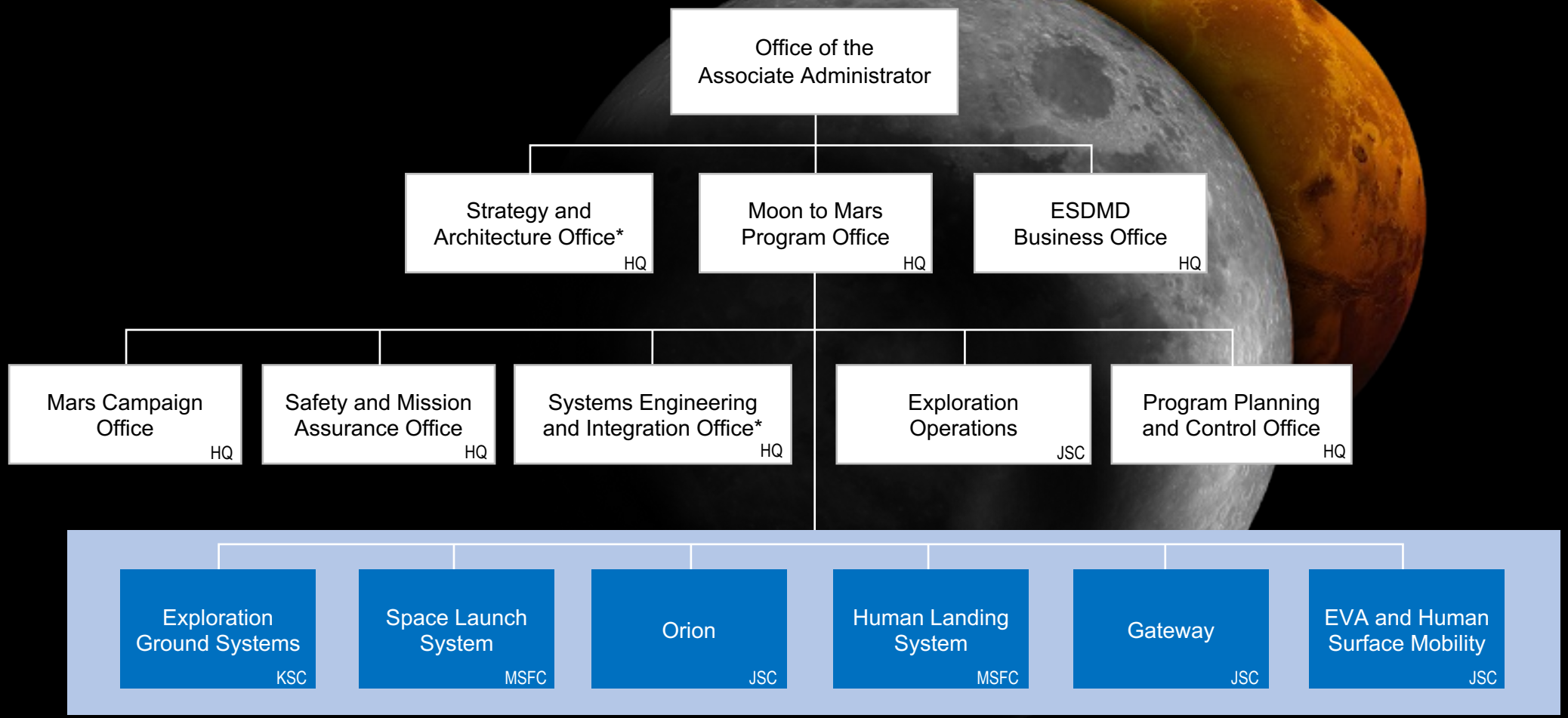
April 26, 2024

Exploration Systems Development Mission Directorate Status

Catherine Koerner

Associate Administrator
Exploration Systems Development Mission Directorate
NASA Headquarters | Washington DC

ESDMD Organization Chart



Exploration Systems Development Mission Directorate (ESDMD) Goals

Note: Mission Safety and Success are not listed as a goal because they are an inherent mandate

ESDMD Goals 2024-2025

- Execute NASA's Artemis missions
- Evolve a sustainable architecture to meet Moon to Mars objectives
- Enable a national deep space transportation capability
- Enhance affordability of all exploration systems
- Expedite toward a yearly mission cadence

To accomplish these goals, we will continue to:

- Foster high standards of program and project management
- Balance funding profile, mission dates, and risks
- Lead international and commercial exploration partnerships
- Collaborate with centers to maintain highly skilled workforce & capabilities
- Communicate clear status and plans for all stakeholders

Moon to Mars Manifest—FY2025 President's Budget Request

FY	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
ESDMD			**Artemis II** (Sep. 2025) Crewed Flight SLS Block 1/ Orion/ML1	**Artemis III** (Sep. 2026) Crewed Flight SLS Block 1/ Orion/ML1 HLS Crewed Lunar Demo xEVA Surface Suits *HLS Uncrewed Lunar Demo* *Gateway PPE/HALO Launch*	*Gateway PPE/HALO Arrival in NRHO*	**Artemis IV** (Sep. 2028) Crewed Flight SLS Block 1B/ Orion/ML2 I-Hab to Gateway Gateway Logistics Services Sustaining HLS Crewed Lunar Demo xEVA Surface Suits *Sustaining HLS Uncrewed Lunar Demo*		**Artemis V** (Mar. 2030) Crewed Flight SLS Block 1B/ Orion/ML2 ESPRIT to Gateway Sustaining HLS Crewed Lunar Demo xEVA Surface Suits LTV	**Artemis VI** (Mar. 2031) Crewed Flight SLS Block 1B/ Orion/ML2 Airlock to Gateway Gateway Logistics Services Gateway External Robotics System TBD Sustaining HLS Services xEVA Surface Suits	**Artemis VII** (Mar. 2032) Crewed Flight SLS Block 1B/ Orion/ML2 Gateway Operations TBD Sustaining HLS Services xEVA Surface Suits Pressurized Rover
SOMD	DSN Upgrades (DLEU) **Completed** DSS-36 [Canberra]	**Completed** DSS-24 [Goldstone]	DSS-34 [Canberra] DSS-56 [Madrid]		Lunar Communications Relay and Navigation Services (LCRNS)–Increment Alpha	Lunar Exploration Ground Sites 1-3 DSS-54 [Madrid] Increment Bravo	Increment Charlie	Ongoing Science, Human Research Program, and Technology Development in LEO (ISS transition to CLD)		
SMD CLPS Flights Outlined	LRO Mars 2020:	ESCAPADE **Attempted** TO 2-AB **Completed** TO 2-IM TO 19D	TO 20A: VIPER HERMES ready for integration ESA Lunar Pathfinder delivered for launch AVATAR (Artemis II) TO PRIME-1 Lunar Trailblazer TO CP-11	Artemis III Surface Science Instruments MMX (MEGANE/ P-Sampler) TO CS-3&4 TO CP-12	LRO continued ops TO CS-06 TO CP-21 TO CP-22	Artemis IV Surface Science Instruments TO CS-6 TO CP-31	Rosalind Franklin Mission (RFM) Launch, Landing TO CP-41 TO CP-42 TO CP-51 TO CP-52 TO CP-61 TO CP-62	Artemis V Surface Science Instruments Artemis LTV Science Instruments	Artemis VI Surface Science Instruments	Artemis VII Surface Science Instruments
STMD	MOXIE; MEDA DSOC	CFM SpaceX TP Flight Demo	Surface Robotic Scouts (CADRE) TO PRIME-1: Drill; Nokia LTE/4G Comm; IM Deployable Hopper CFM ULA TP Flight Demo PPE SEP qual. environ. complete CFM Eta Space TP Flight Demo	CFM Lockheed Martin TP Flight Demo NEP Concept Design	DRACO Demonstration	TO LIFT-1: Lunar Surface Power Demo (i.e., RFC, VSAT, Wireless Charging); Lunar Surface Scaled Construction Demo 1; ISRU Pilot Excavator; ISRU Subscale Demo	SEP qual. complete			Fission Surface Power demo delivered for launch TO LIFT-2: Lunar Surface Scaled Construction Demo 2; Autonomous Robotics Demo; Deployable Hopper 2; ISRU Subscale Demo 2

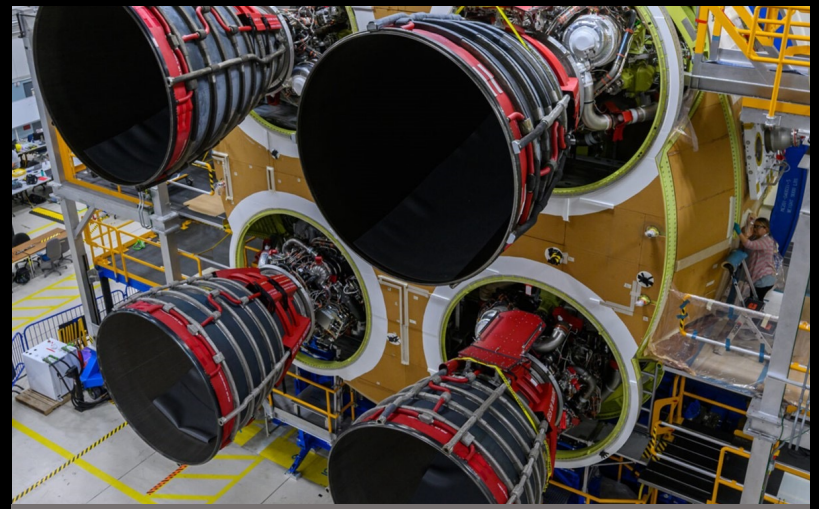
Icons are representative only, and may not reflect final configurations, not to scale | Icons represent the fiscal year in which an event occurs | Based on FY 2025 President's budget request

Presentation Version: 040824

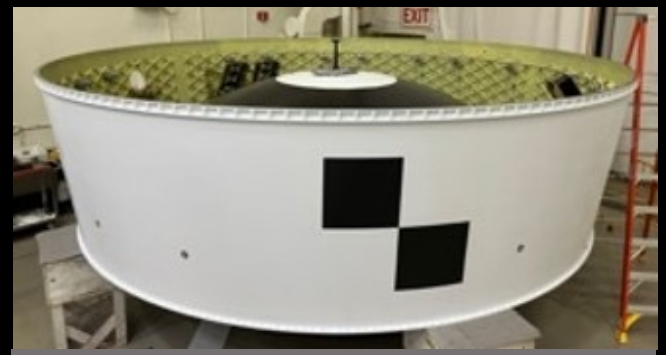
Artemis II Progress

January 24, 2024—In preparation for the Artemis II crewed mission, EGS teams begin installation of four emergency egress baskets at Launch Complex 39B

The Artemis II crew stand on the crew access arm of the mobile launcher at Launch Pad 39B as part of an integrated ground systems test



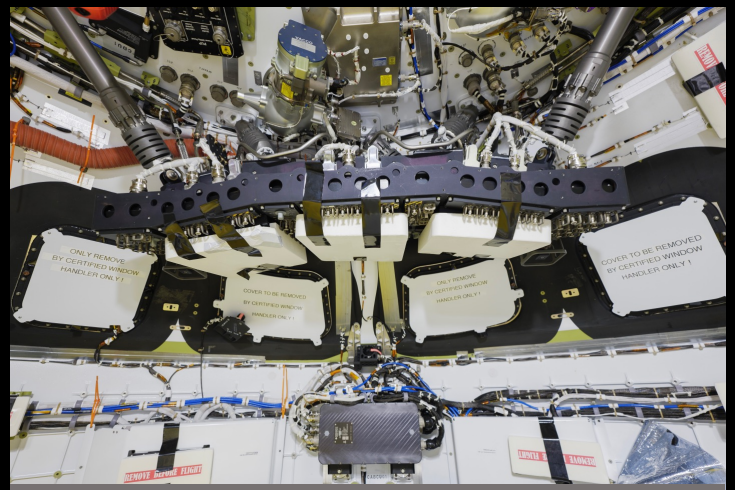
Artemis II core stage with installed engines undergoing final outfitting



Artemis II Orion stage adapter with docking target and diaphragm installed

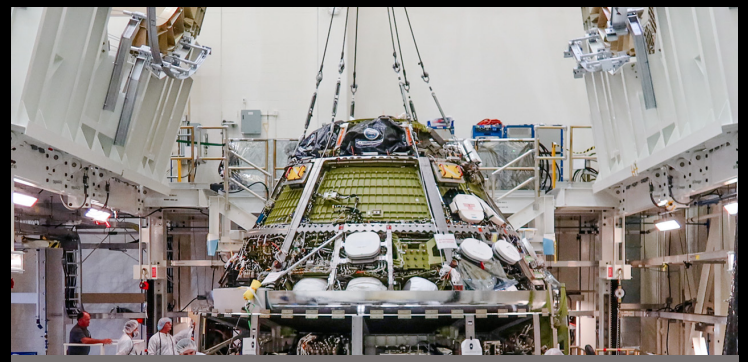
Artemis II booster motor segments receive "worm" logotype in the Rotation, Processing and Surge Facility at Kennedy Space Center

Artemis II Progress



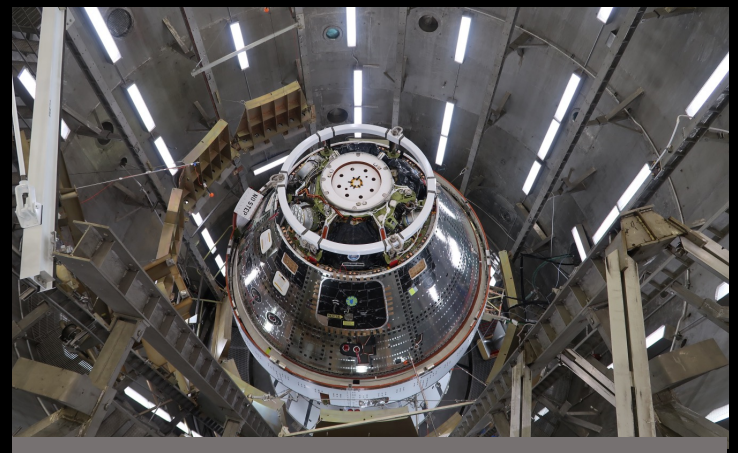
Artemis II Orion Crew Module Interior

Artemis II Service Module



Integration of Crew and Service Modules for the Artemis II Orion Spacecraft

Artemis II Orion Spacecraft is lifted into an altitude chamber at NASA's Kennedy Space Center for electromagnetic interference/compatibility testing



Artemis II Orion Spacecraft inside the altitude chamber at NASA's Kennedy Space Center for testing

Orion environmental test article being prepared for vibro-acoustic testing at NASA’s Neil Armstrong Test Facility

Artemis II Progress

Teams conducted a cryogenic simulation for the Artemis II mission inside Launch Control Center Firing Room 1 at Kennedy Space Center. During this operation, the launch team practiced loading the super-cool liquid propellant on the SLS.

Artemis II crew members Reid Wiseman (foreground) and Jeremy Hansen participate in training in the Orion simulator

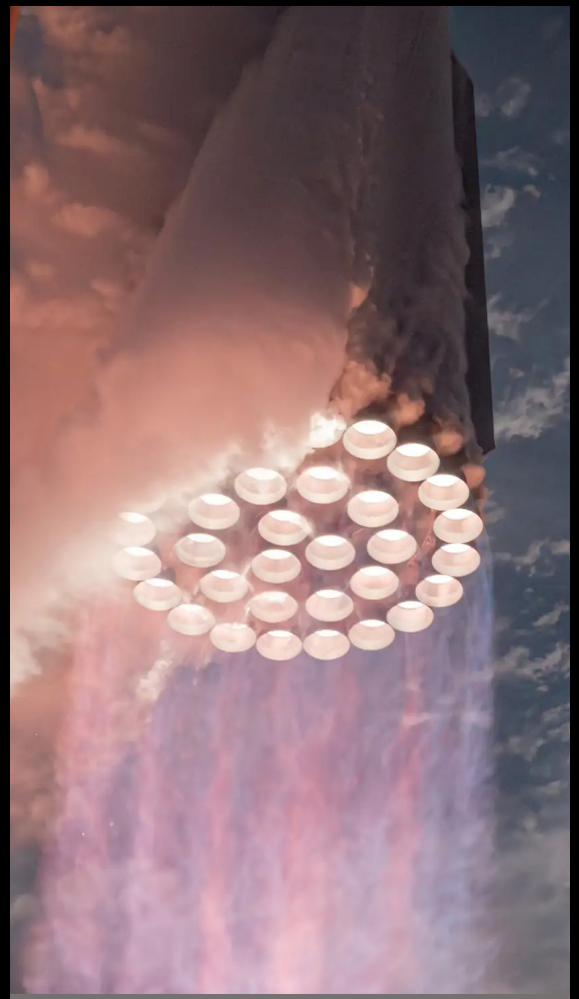
The four Artemis II astronauts practiced procedures to exit the Orion spacecraft in an emergency

U.S. Navy personnel grab onto a mockup of the Orion spacecraft during a practice procedure of the Underway Recovery Test 11 (URT-11)

NASA Artemis II crew members are assisted by U.S. Navy personnel as they exit a mockup of the Orion spacecraft in the Pacific Ocean during URT-11

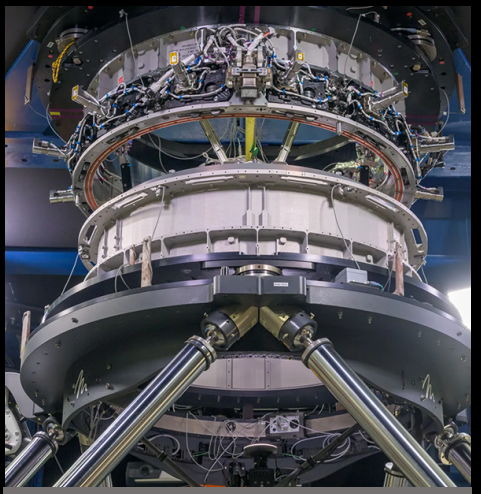
Starship Human Landing System Progress

March 14, 2024—Starship third integrated test flight. Credit: SpaceX



March 14, 2024—For the second time, all 33 Raptor engines on the Super Heavy Booster started up successfully and completed a full-duration burn during ascent. Credit: SpaceX

March 14, 2024—Starship third integrated test flight. Credit: SpaceX



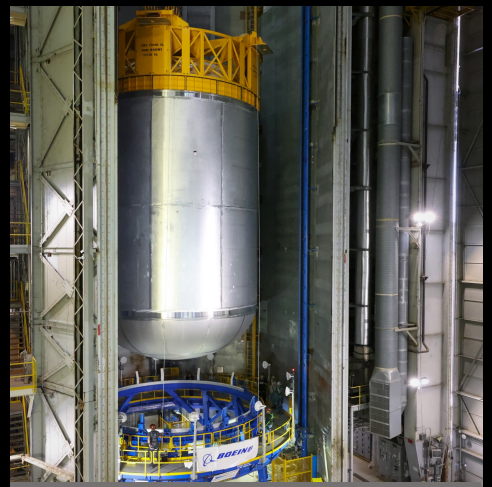
Starship Human Landing System docking system qualification test

Starship Human Landing System elevator astronaut testing

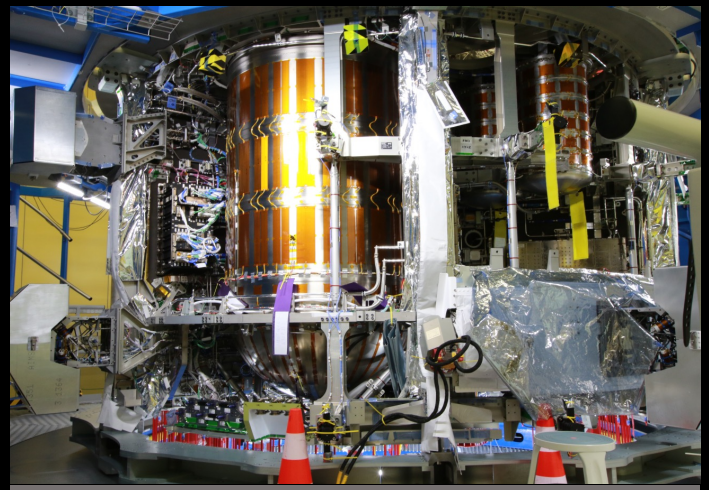
Artemis III Progress

All Artemis III booster motor segments complete

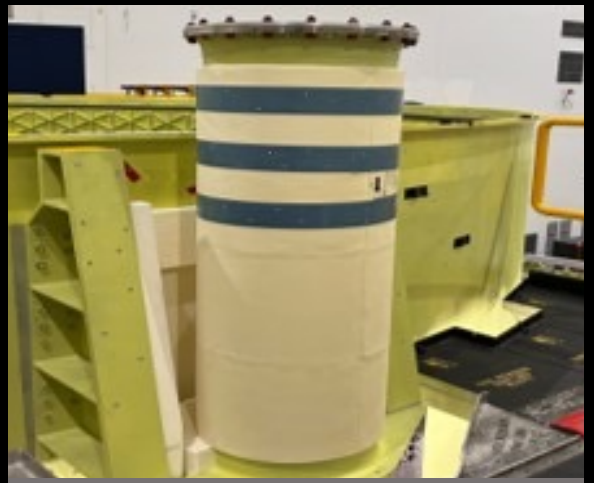
Artemis III launch vehicle stage adapter has completed frangible joint assembly



Artemis III SLS core stage liquid oxygen tank moved to Cell D at Michoud



European Service Module 3 integration in Bremen cleanroom



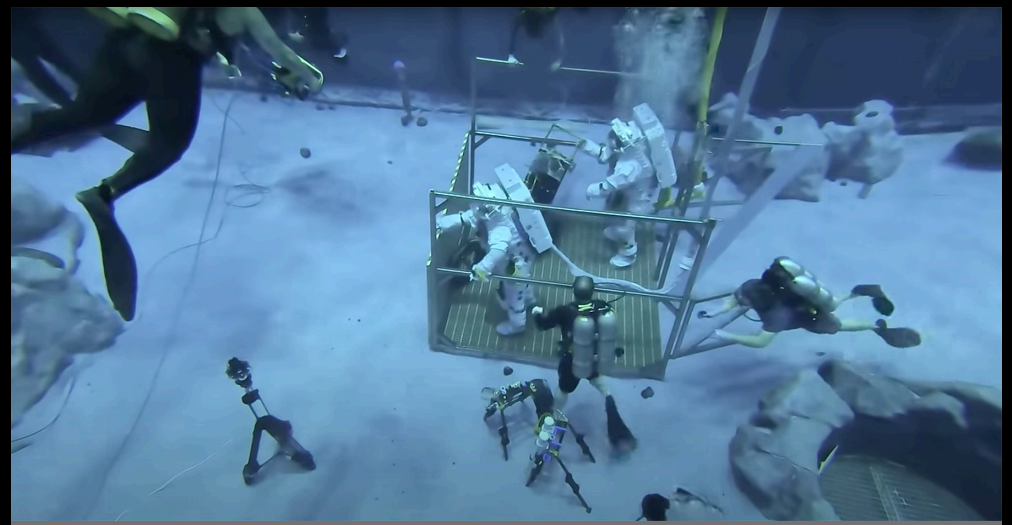
Artemis III SLS engine section at Kennedy Space Center

Artemis III interim cryogenic propulsion stage in Delta Operations Center

Artemis III crew module integration

Artemis III Progress

AxEMU spacesuit
during testing



Astronauts Victor Glover and Christina Koch practice runs on a
Starship elevator mockup in the Neutral Buoyancy Laboratory

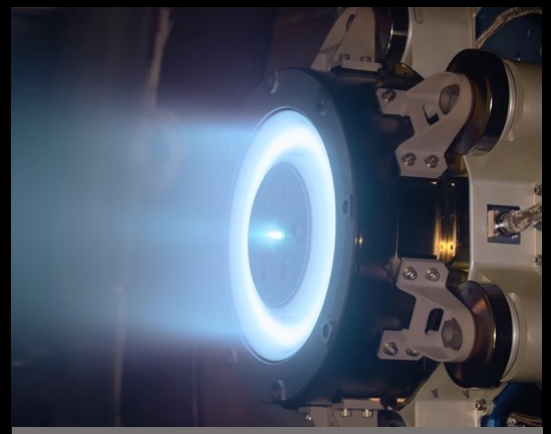
Spacesuit and hardware tests on the simulated lunar
terrain on the Neutral Buoyancy Laboratory (NBL) pool floor

The Joint Extravehicular Activity and Human Surface Mobility Program Test Team (JETT) testing tools and spacesuits in a rock
yard at NASA's Johnson Space Center, simulating the uneven terrain of the lunar surface, in preparation for Moonwalks

Spacesuit and EVA hardware testing in the NBL

Gateway Initial Capability Progress

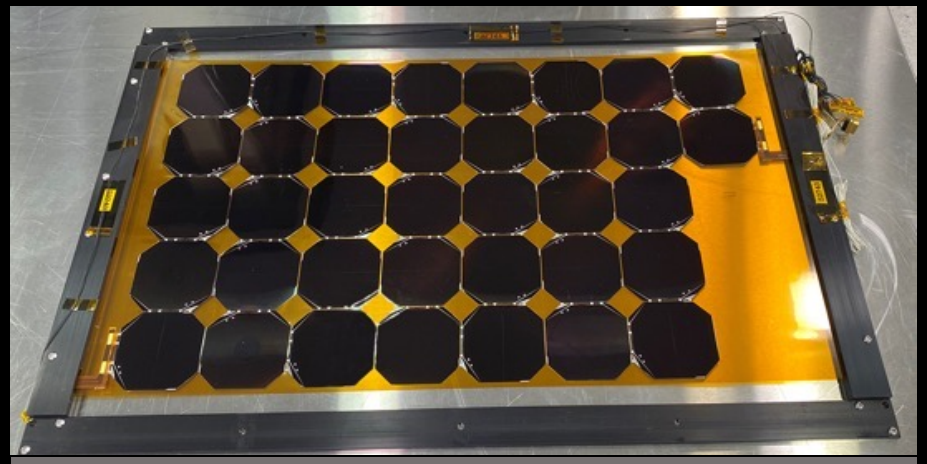
PPE Roll Out Solar Array (ROSA) Boom



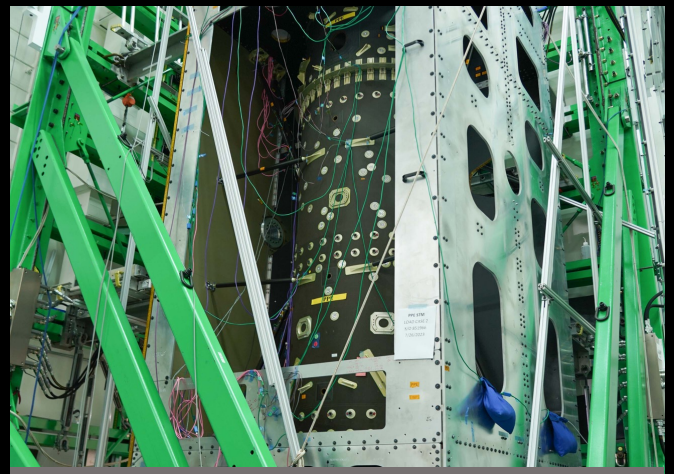
Power and Propulsion Element 12-kilowatt Solar Electric Propulsion Test

Gateway advanced electric propulsion system qualification thruster

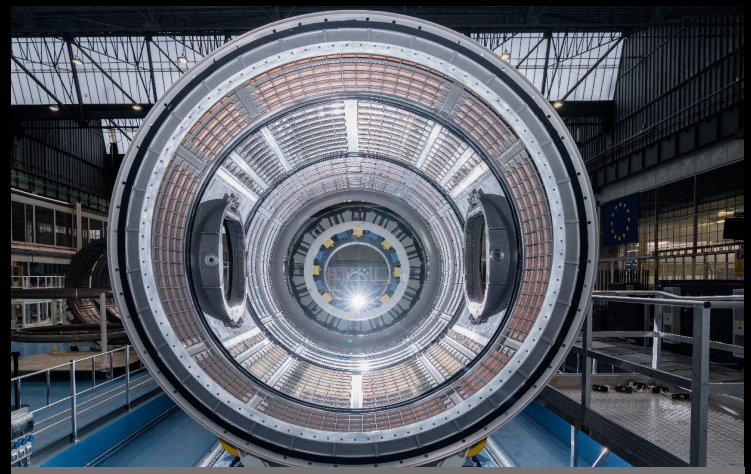
Engineers at Thales Alenia Space Italia gently guide HALO from its welding platform to an integration test stand.



Power and Propulsion Element (PPE) Solar Array Power Module



Power and Propulsion Element central cylinder testing at Maxar



Habitation and Logistics Outpost after completion of final welds in Turin, Italy

Artemis IV Progress

ML-2 truss work

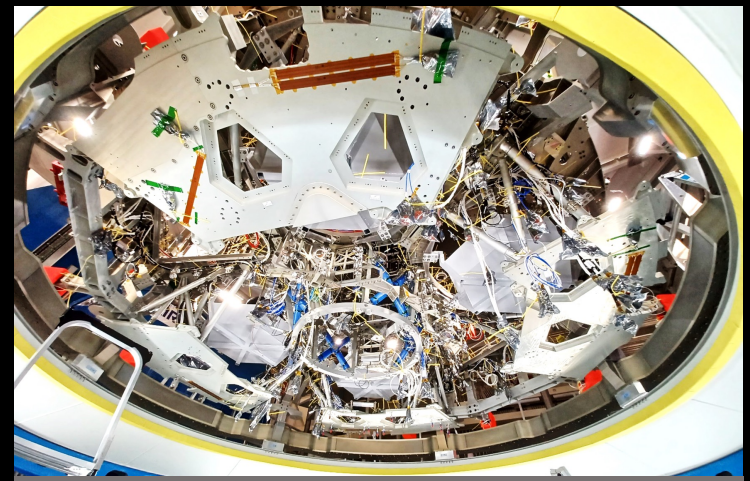
Artemis IV payload adapter engineering development unit ready for evaluation

Artemis IV Crew Module Pressure Vessel at Kennedy Space Center

ML-2 tower module

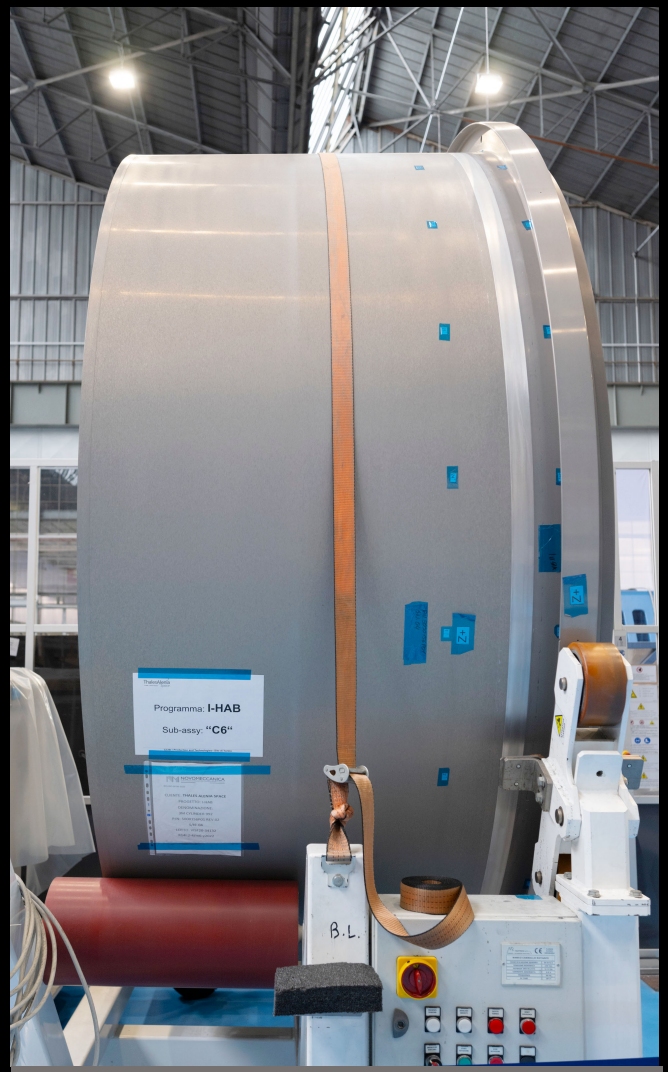
Artemis IV universal stage adapter development test article at Marshall for testing

Artemis IV engine section in progress



Artemis IV European Service Module in Bremen, Germany

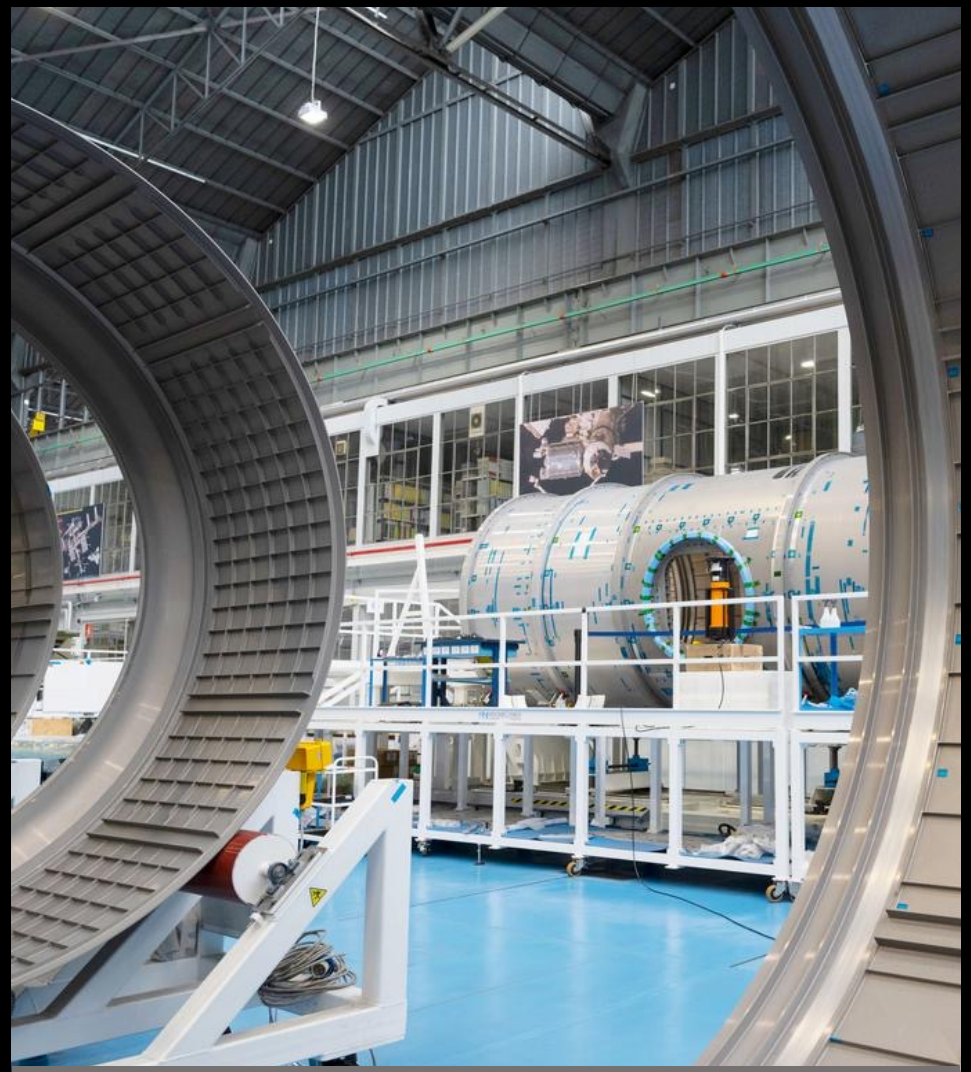
Artemis IV Progress – Gateway



Gateway's Lunar I-Hab module under construction at Thales Alenia Space facility in Turin, Italy.

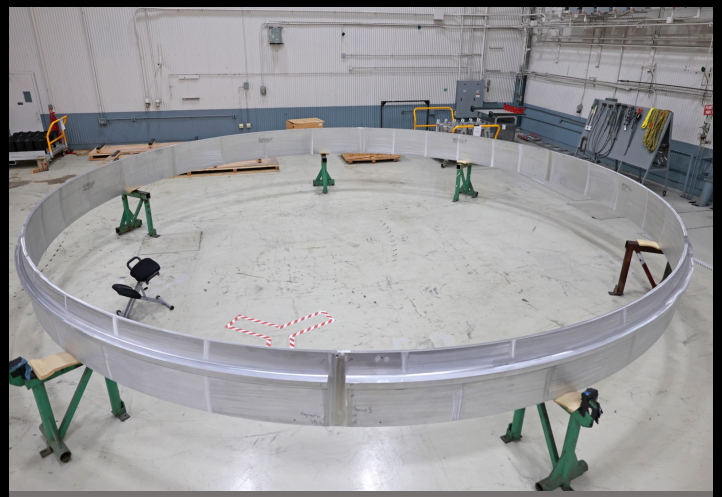
Early hardware for Lunar I-Hab that will be delivered to Gateway on Artemis IV

Early hardware for Lunar I-Hab

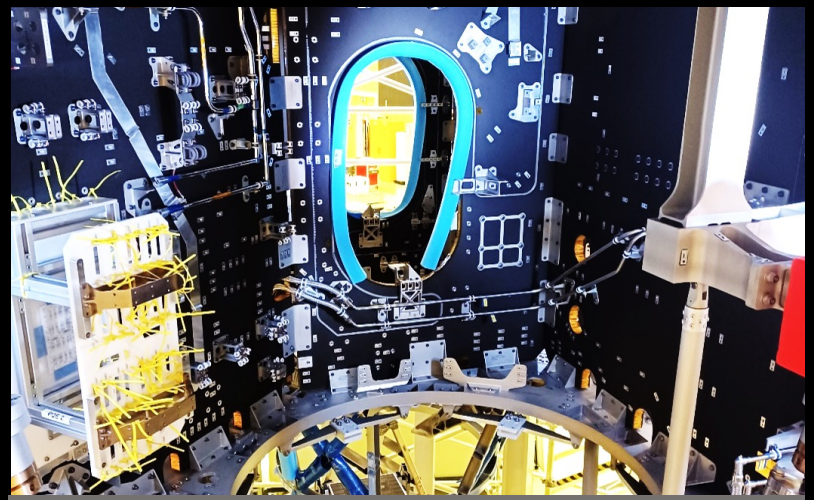


Pieces of Lunar I-Hab with HALO module visible in center, back of image

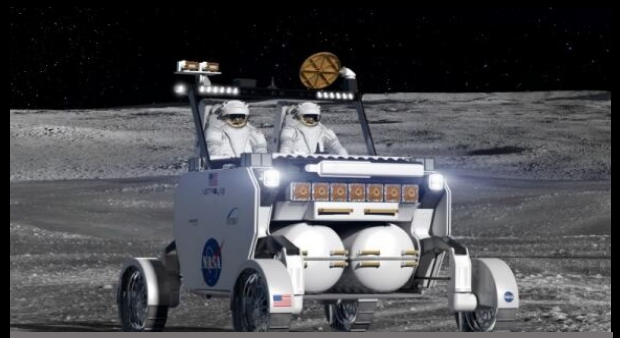
Artemis V Progress



Artemis V Y-ring manufactured at Michoud Assembly Facility



European Service Module-5 at the Airbus Integration Hall in Bremen, Germany



Artist's concept of Venturi Astrolab's FLEX lunar terrain vehicle. Credit: Astrolab

Certification testing for production of new RS-25 Retrofit 3b engines to power the SLS rocket, beginning with Artemis V, completed early April 2024

Orion crew module pressure vessel welding has begun at NASA's Michoud Assembly Facility

Artist's concept of Lunar Outpost's Lunar Dawn lunar terrain vehicle. Credit: Lunar Outpost

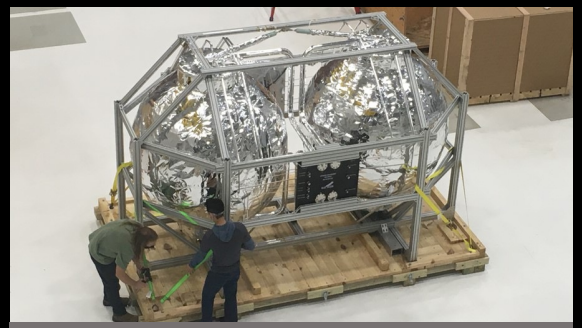
Artist's concept of Intuitive Machines' Moon RACER lunar terrain vehicle. Credit: Intuitive Machines

Blue Moon Human Landing System Progress

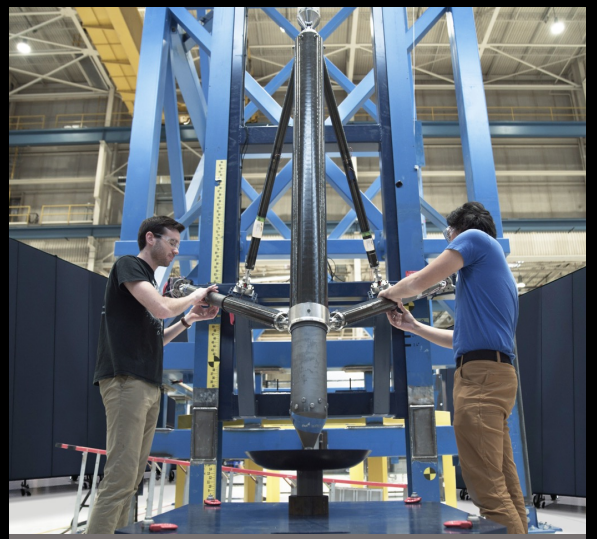
A Blue Origin technician conducts a vacuum chamber fit check for a fuel cell at Blue Origin's facility in West Texas.

Blue Origin's BE-7 team conducted a successful Thrust Chamber Assembly test at NASA Marshall Space Flight Center.

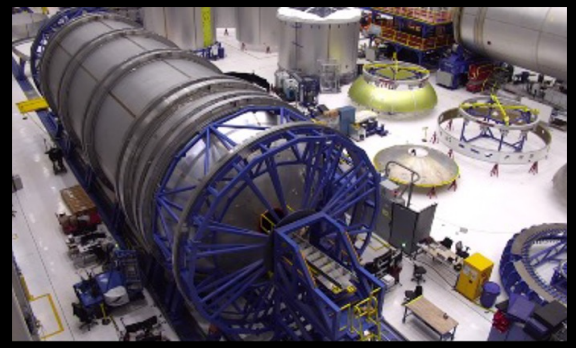
The first and second stages of New Glenn's test vehicle mated for the first time enabled Blue Origin to exercise their tooling and stage interfaces in preparation for the first launch.



Dual Tank Cryo Fluid Management Test Article. Credit: Blue Origin



Blue Origin conducted a drop test of the Blue Moon MK1 cargo lander leg to provide engineers with data to correlate design models for dynamic loads analysis.



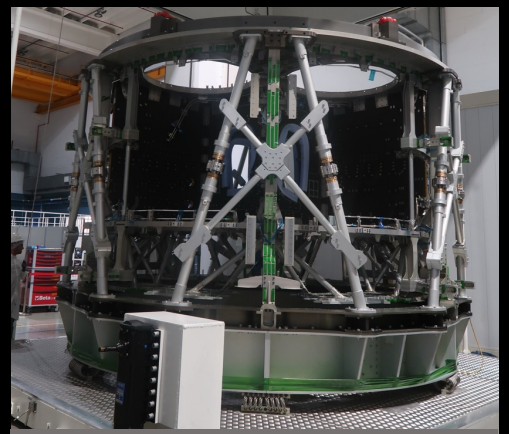
Hardware for Blue Origin's New Glenn second stage, which will refuel the cislunar transporter as part of Blue Origin's Artemis V architecture, is being manufactured at Blue Origin's production facility in Cape Canaveral, FL.

Blue Origin's New Glenn rocket upended on its launch pad for the first time. The rocket's first stage underwent three tanking tests in preparation for its first launch.

New Glenn test article on Blue Origin's launch pad at LC-36

Beyond Artemis V Progress

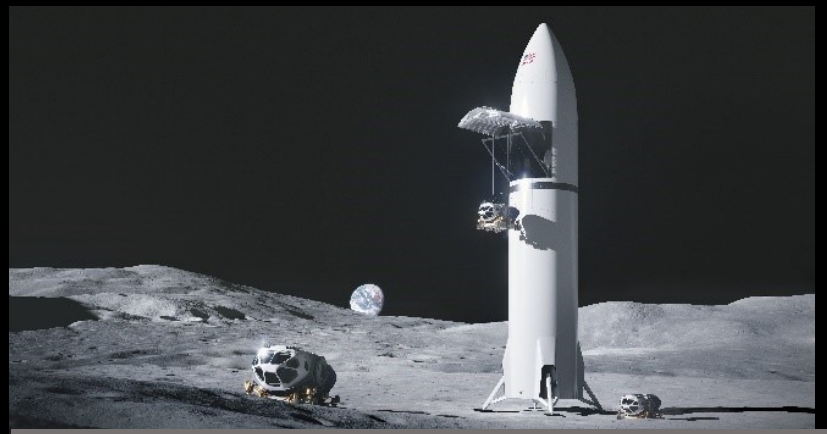
NASA Administrator Bill Nelson, left, and Japan's Minister of Education, Culture, Sports, Science and Technology Masahito Moriyama, hold signed copies of an historic agreement between the U.S. and Japan. Under the agreement, Japan will design, develop, and operate a pressurized rover for crewed and uncrewed exploration on the Moon. NASA will provide the launch and delivery of the rover to the Moon as well as two Japanese astronaut missions to the lunar surface.



The European Service Module 6 structure ahead of shipment to the Airbus Integration Hall in Bremen, Germany

BOLE DM-1 Booster Segment complete for Artemis IX

Artist's concept of a pressurized rover. Credit: JAXA/Toyota



Early conceptual renderings of cargo variants of human lunar landing systems from NASA's providers SpaceX, left, and Blue Origin, right. Both industry teams have been given authority to begin design work to provide large cargo landers capable of offloading 15 metric tons of cargo, such as a pressurized rover, on the Moon's surface. (SpaceX and Blue Origin)