NASA Advisory Council

Human Exploration and Operations Committee

Exploration Systems Development Mission Directorate

Moon to Mars Program

Amit Kshatriya, Deputy Associate Administrator
Lakiesha Hawkins, Assistant Deputy Associate Administrator
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August 29, 2024

Artemis II Progress

Artemis II Progress

- Crew & Service Module (CSM) successfully completed Electromagnetic Interference and Compatibility (EMI/EMC) testing in the Altitude Chamber.
- Vacuum testing was completed in early July and post-vacuum functionals were completed. The vehicle is currently undergoing propulsion system close-out testing.
- Environmental Test Article (ETA) is continuing with preparations for abort vibration testing start targeting September at the Armstrong Test Facility.
- CSM vehicle is currently undergoing propulsion system close-out testing.
- Completed replacement and installation of the ECLSS digital motor controller hardware.
- Removed flight Crew Module batteries and began repair procedures.

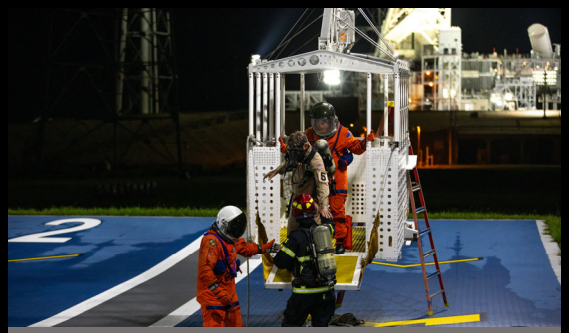
Artemis II Orion spacecraft lifted out of a vacuum chamber after EMI/EMC testing

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

Artemis II Progress

- Completed EGS Booster offline processing
- Ongoing Integrated System Verification & Validation
  - Completed Pad Environmental Control System Verification & Validation (V&V)
  - VAB Environmental Control System
  - Launch Cooling Test and Cryogenic Cold Flow Part 1 (Legacy Tank to ML-1) completed
- Completed Crawler Transport 2 motor refurb and verification testing
- EGS Launch Team Training underway

Artemis II offline processing (center booster motor segments) in the rotational processing and surge facility



EGS teams practice the emergency escape or egress procedures at Launch Complex 39B

Members of the closeout crew, pad rescue team and the Exploration Ground Systems Program practiced walking to the crew access arm

Mobile Launcher 1 prepares for Artemis II launch

Artemis II Progress

- Core stage offloaded July 24 and moved to the Vehicle Assembly Building. Pre-processing is in work before integrating other Artemis components
- Launch Vehicle Stage Adapter left MSFC and headed to KSC
- Software installation ongoing on the Artemis II core stage flight computers to support vehicle processing at KSC and the upcoming Artemis II mission
- Boosters' forward assemblies are complete and ready to turn over to EGS.
- Interim Cryogenic Propulsion System efforts underway to close remaining open work prior to transfer to EGS in October 2024
- Payload dispensers for the Artemis II secondary payloads have arrived at MSFC
- Orion Stage Adapter (OSA) complete and ready to ship to KSC, planned for early November 2024

Pegasus Barge Headed to KSC

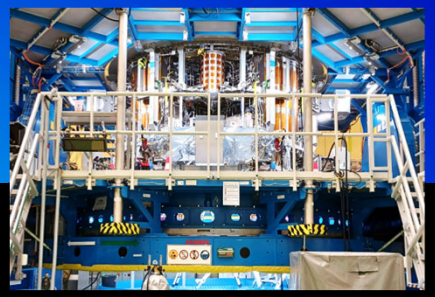
Core Stage Entering
Vehicle Assembly Building at KSC

Launch Vehicle Stage Adapter loading on to the agency's Pegasus barge to ship to KSC


Artemis III Progress

Artemis III Progress

- European Service Module (ESM) is complete and ready to be shipped to Kennedy Space Center in September.
- Completed Crew Module (CM) parachute closeout panel installation.
- Artemis III NASA Docking System (NDS) acceptance testing complete, delivered to KSC for integration.
- Interim Cryogenic Propulsion System completed final testing and checkout.
- Launch Vehicle Stage Adapter is in final phase of integration.
- All five major elements of the core stage are structurally complete with integration and outfitting ongoing at both Michoud Assembly Facility and Kennedy Space Center.





Images (L to R): 1) European Service Module (ESM) 3 undergoing final propulsion testing in Bremen, Germany; 2) KSC's Vehicle Assembly Building High Bay 2 vertical tooling progressing with first working platform installation in progress; 3) Artemis III left-hand thrust vector control buildup in work in Booster Fabrication Facility; 4) Artemis III core stage boattail lift at Michoud; 5) Artemis III LOX tank at Michoud.

Artemis III Progress

- Completed SpaceX Integrated Flight Test 4 in June 2024.
- Path to SpaceX Integrated Flight Test 5, expected Fall 2024.
- Performed Suited Human In the Loop Testing (HITL) with HLS, EHP, SpaceX, and Axiom in May 2024.
- Construction underway for second SpaceX Launch Pad at Boca Chica, TX.
- Completed EVA Development Preliminary Design Review; Suits are progressing.

Suited Human-In-The-Loop Testing

SpaceX Integrated Flight Test #4 launched June 6, 2024. Photo Credit: SpaceX

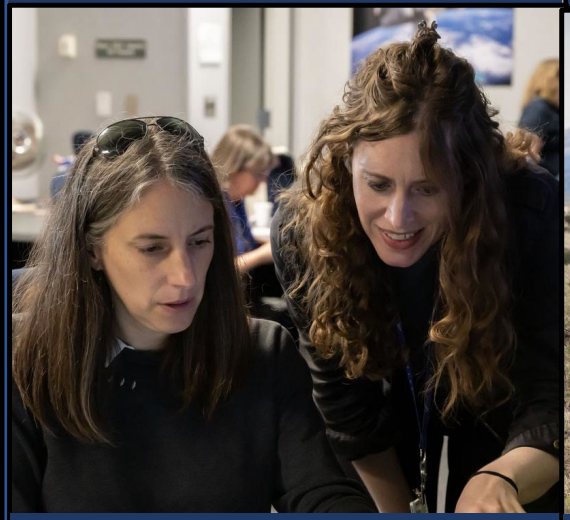
JETT 5 Integrated Field Test

Joint Extravehicular Activity and Human Surface Mobility Test Team

- Highest fidelity Artemis Moon-walk simulation to date
- Location near Flagstaff selected for its volcanic terrain, an excellent lunar-surface analog
- Field tested Artemis technology, including augmented-reality navigation and new logistics software
- Flight controllers, scientists, and image analysts at NASA Johnson Space Center monitored and guided mission activities

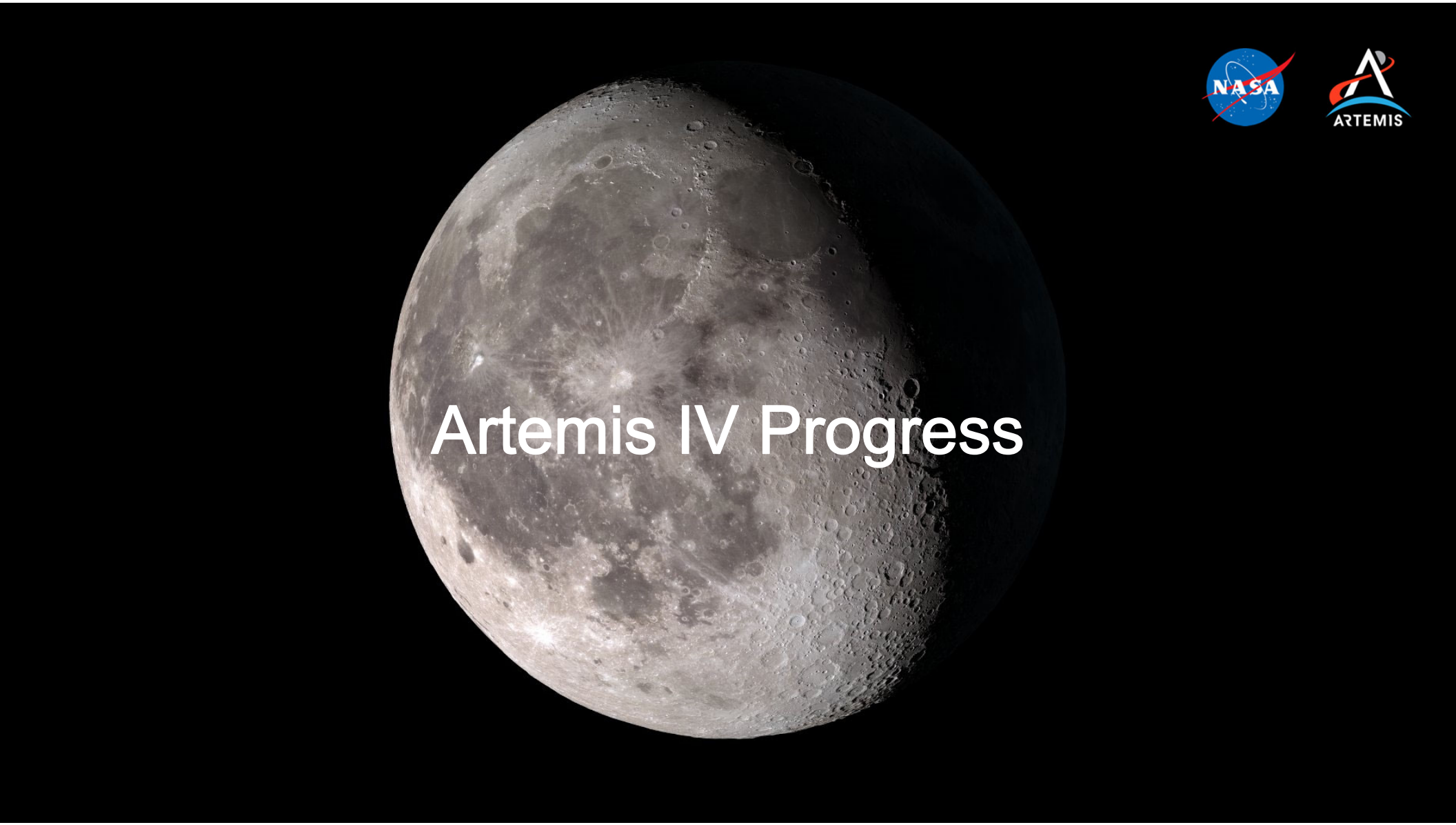
Andre Douglas, left, and Kate Rubins

Science Evaluation Room, JSC



Julianne Gross, left, and Brett Denevi
SMD Geology Team

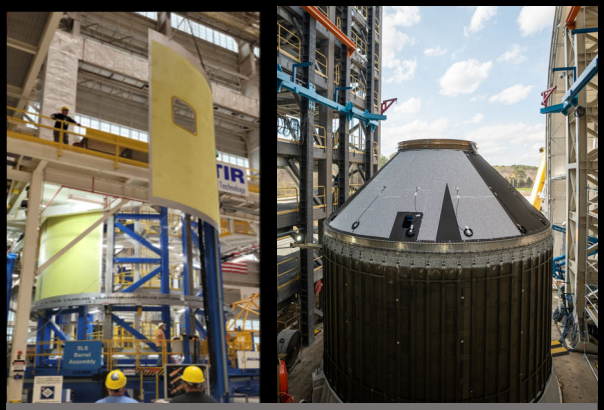
First JETT 5
Simulated Moon Walk


Artemis IV Progress

Artemis IV Progress

- European Service Module assembly and integration continues in Bremen, Germany.
- Five (5) barrel sections of the core stage liquid hydrogen tank are complete, and the engine section has been manufactured and is currently being outfitted.
- All four (4) RS-25 engines for the Core Stage have completed processing as of July 3, 2024.
- Seven (7) Artemis IV booster motor segments have been cast with propellant; aft skirt structures refurbishment is complete; Northrop Grumman is fabricating nozzles.
- Universal Stage Adapter (USA) development test article currently undergoing modal and structural testing at MSFC.
- USA payload adapter is being built at MSFC, engineering unit of this hardware completed modal testing.

Artemis IV Crew Module Adapter, KSC O&C



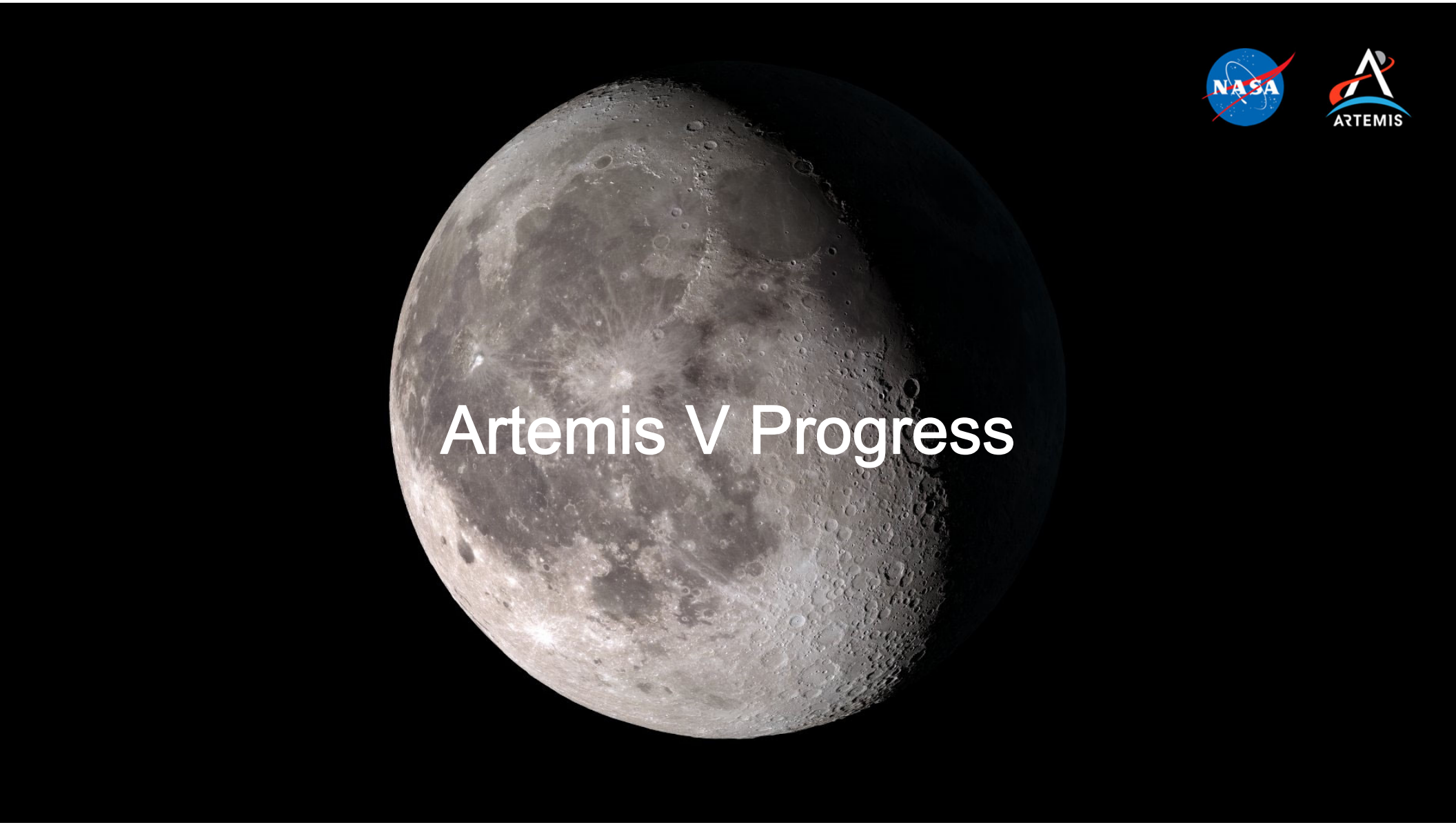
Artemis IV EUS interstage panel for structural qualification article at Vertical Weld Center; 2) Artemis IV payload adapter Nest EDU modal testing complete at MSFC Test Stand 4697

Artemis IV Progress

- Mobile Launcher 2 (ML-2) development has gained momentum over the last year with fabrication 70% complete and construction at 25%.
  - Completed the ML-2 “Jack & Set” milestone in May 2024
  - Primary structures for Tower Modules 4-7 are erected
  - Next major milestone is the “Rig & Set”
- All PPE tanks received at Maxar. Completed processing and installation.
- HALO primary structure static load tests complete.
- Working towards Artemis IV Lander (SpaceX) Preliminary Design Review – Spring 2025.

Teams with NASA’s Exploration Ground Systems Program and primary contractor, Bechtel National, Inc., move the base structure of ML2 to a permanent mount structure

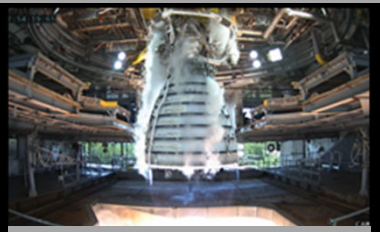
First Xenon tank being installed in the PPE central cylinder.
Photo by Maxar Space Systems


Artemis V Progress

Artemis V Progress

- Lunar Terrain Vehicle Service (LTVS) Contracts awarded to three vendors, Intuitive Machines, Lunar Outpost, AstroLab Venturi.
- Completed agreement with Japan for the provision of the Pressurized Rover, which will also host multiple science instruments.
- Canadian Space Agency contract with MDA Space for the Gateway External Robotics System (GERS) Canadarm3 (Phase C/D).
- Mohammed bin Rashid Space Centre (MBRSC) of the United Arab Emirates (UAE) request for proposal for the Gateway Airlock announced.
- Blue Origin New Glenn 1st Stage Engineering Development Unit Tanking Test at Launch Complex 36 – June 2024.
- Blue Origin Research Engine for BE-7 testing at Air Force Research Lab (AFRL) Hot Fire – July 2024.
- Final series of hot fire tests required to certify the new production RS-25 engines for flight beginning with Artemis V and beyond completed – July 2024.
- All five (5) of the SLS Block 2 Booster Obsolescence and Life Extension (BOLE) DM-1 motor segments are being finalized.

Gateway, GERS-Canadarm3



SLS – RS-25 Engine

Blue Origin – New Glenn
Credit: Blue Origin

Mars Campaign Office:
Mars Risk Reduction Through Artemis

Mars Campaign Office

Leading technology development in 58 different task areas across its five Domains: Crew Health & Performance, Earth Independent Operations, Environmental Control & Life Support Systems, Surface Systems, and Transportation & Vehicle Systems.

Recent accomplishments include:

Crew Health & Performance

- **Ohalo Crop Production Facility:** The engineering design unit (EDU) assembly completed in March and testing continues.
- **Exploration Exercise System:** Completed E4D (Enhanced European Exploration Exercise Device) functional testing in Odense, Denmark. Summer 2024 hardware delivery for ISS technology demonstration in Spring 2025. VIS (Vibration Isolation System) undergoing rotational assembly spring redesign after failure during lifecycle testing.

Earth Independent Operations (EIO)

- **EIO State of the Agency assessment –** EIO is developing & maturing technologies for the crew to respond to critical situations in the absence of real-time ground control support. Working to transition existing investments, and center capabilities that can support the mission.

Environmental Control & Life Support Systems (ECLSS)

- **MinION -** used to identify the bacteria in the ISS waster water tank, first-time metagenomics was performed on orbit, and it provided the first microbial study of the wastewater tank.
- **UWMS** dose pump titanium check valve and integrated conductivity sensor repair are in work. Both components will be integrated into the UWMS dose pump assembly and is expected to be ready for flight by summer FY25

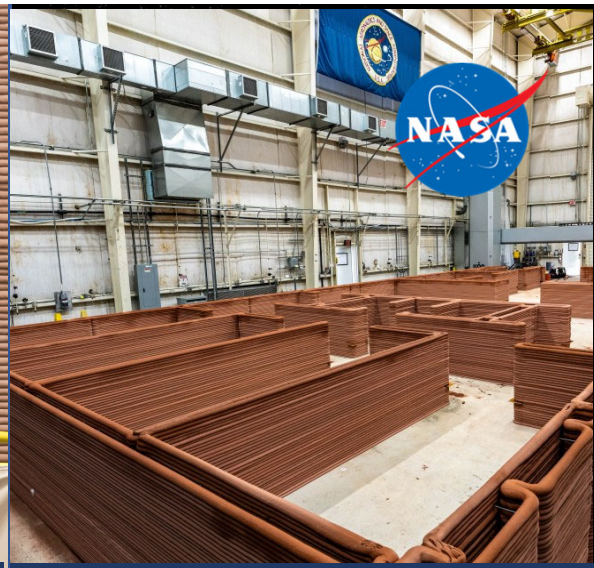
Top images: MinION operations with Dr. Jeanette Eps and Dr. Mike Barret – ISS. **Bottom images (L to R)** : E4D functional testing – Denmark and Ohalo Crop Production EDU testing – KSC.

First CHAPEA Mission

Crew Health and Performance Exploration Analog

- Completed first of three simulated missions to understand crew health and performance during future missions to Mars
- Mars Dune Alpha: 3D-printed structure designed to simulate a Mars habitat
- Included high-fidelity “Mars walks,” robotic operations, habitat maintenance, exercise, crop growth, and responses to intentional environmental stressors
- Human research included routine biological testing, fitness assessments, and psychological analyses
- ESDMD provided funding for CHAPEA through the Mars Campaign Office

Mission Began June 25, 2023



Construction of Mars Dune Alpha

Glovebox Training Station

Mission Completed July 6, 2024