National Aeronautics and Space Administration

Moon to Mars Program Office Updates

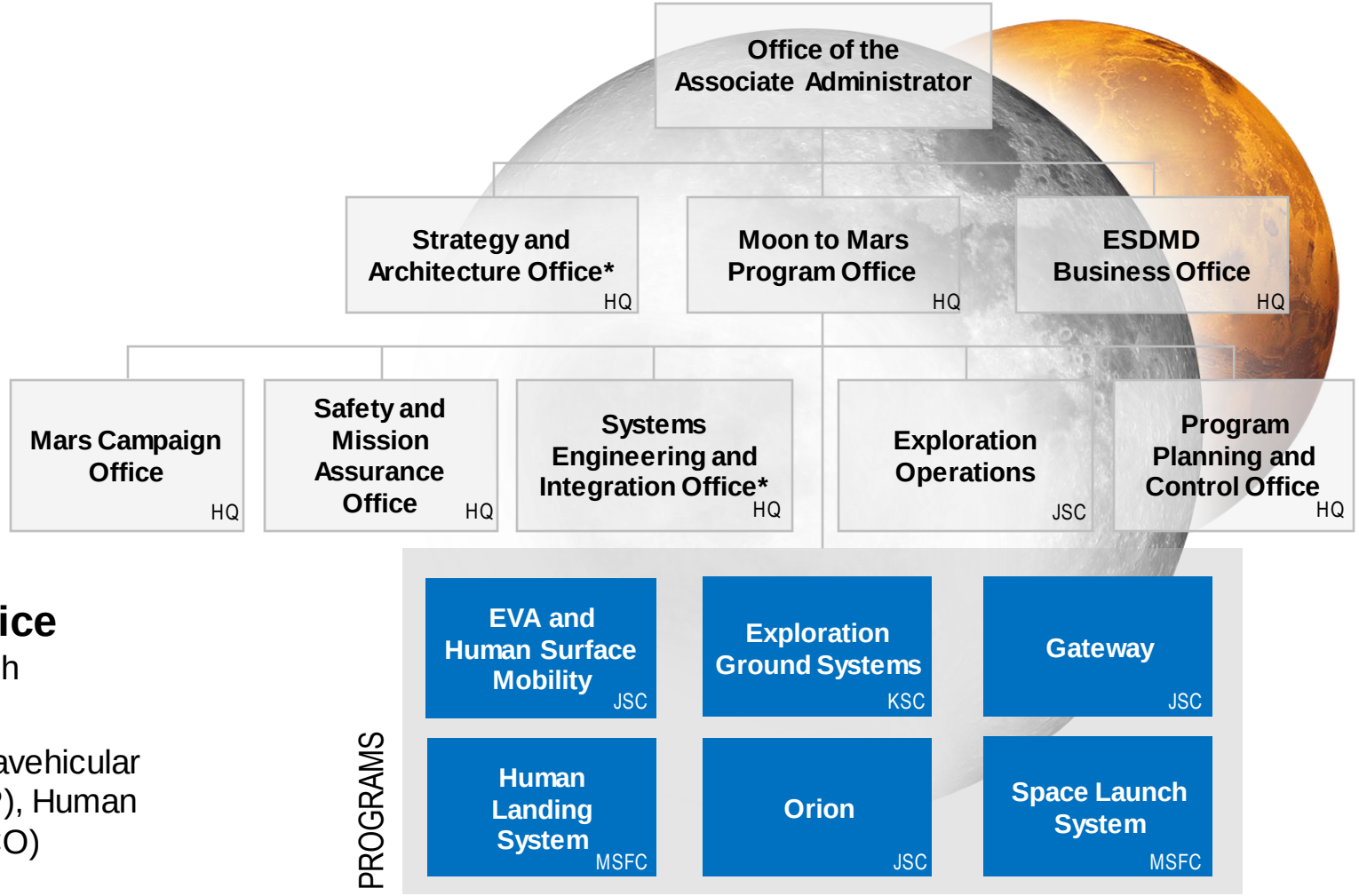
Moon to Mars Program Office Updates

The Program Office

- Helps ensure that NASA successfully establishes a long-term lunar presence needed to prepare for humanity's next giant leap to the Red Planet
- Focuses on hardware development, mission integration, and risk management functions for programs critical to the agency's exploration approach that uses Artemis missions at the Moon to open a new era of scientific discovery and prepare for human missions to Mars
- Leads planning and analysis for long-lead developments to support human Mars missions

Artemis Programs under the Program Office

- Transportation System Theme: Orion, Space Launch System, Exploration Ground Systems
- Lunar System Development Theme: Gateway, Extravehicular Activity and Human Surface Mobility Program (EHP), Human Landing System (HLS), Mars Campaign Office (MCO)



**Strategy and Architecture and SE&I have direct integration with SMD and STMD*

ARTEMIS I

First mission (uncrewed flight test)

COMPLETE

ARTEMIS II

First crew

CREW SELECTED

ARTEMIS III

First human surface landing

Artist's Concept

ARTEMIS IV

First lunar space station assembly mission

Artist's Concept

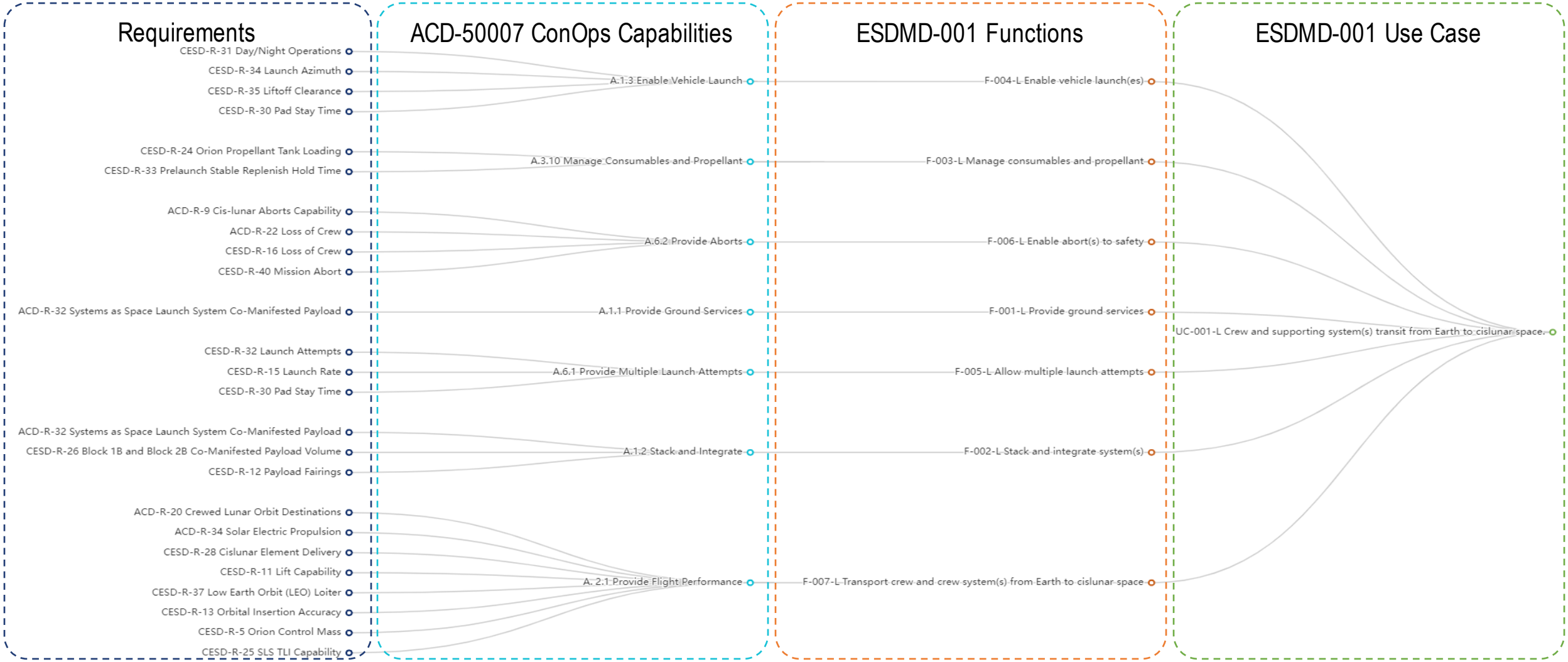
ARTEMIS V

Crewed mobile surface exploration, Gateway expansion

Artist's Concept

Implementing the Architecture

Requirements Flow Down for Use Case 001: Crew and supporting system(s) transit from Earth to cislunar space



Artemis I

MISSION COMPLETE:

The Artemis I mission launched on November 16, 2022, and the Orion spacecraft successfully splashed down on December 11, 2022.

ARTEMIS FIRSTS:

- Integrated uncrewed flight test of the Space Launch System (SLS) rocket, Orion spacecraft, and Exploration Ground Systems (EGS) at Kennedy Space Center
- Demonstration of Orion heatshield at lunar re-entry conditions
- Science activities via payloads in Orion and CubeSats deployed from SLS

NEW ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1 and upgraded ground systems

Current Post-Artemis I Work

Engineers first opening of Orion hatch inside the Kennedy Space Center Multi-Payload Processing Facility

- Avionics boxes extracted for reuse on Artemis II and some installed on Artemis II. Others currently at vendor for retest and recertification
- Heat shield removed on February 9
- Capsule to be sent to Armstrong Test Facility for environmental testing
- Significant damage to launch pad and systems being assessed—some repair work underway

Artemis II

ARTEMIS FIRSTS:

- Crewed integrated flight test of the Space Launch System (SLS) rocket, Orion spacecraft, and Exploration Ground Systems (EGS) at Kennedy Space Center
- Demonstration of Orion life support systems
- Human data collection in transit to and from the Moon, in lunar orbit, and through reentry and splashdown
- Conducting new science and technology demonstrations in orbit

NEW ELEMENTS:

- Orion life support systems
- Launch Complex 39B emergency egress system for crew and new liquid hydrogen system

COMMON ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1 and upgraded ground systems

ENSURING CREW SAFETY:

- Addressing a battery issue and a circuitry component responsible for air ventilation and temperature control in Orion, and investigating root cause of char loss from the Artemis I heat shield

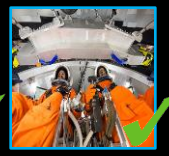
Major Milestones for Artemis II

Rev. K - As of 1/23/2024


PARACHUTES QUALIFIED FOR FLIGHT


*CREW EGRESS TRAINING AT NBL


ORION PRESSURE VESSEL ELEMENTS MACHINED


*HAND CONTROLLER EVAL


*DOCKING HATCH EVAL


ORION WATER IMPACT TESTING


*CREW EMERGENCY EGRESS TESTS


*CREW AT SEA TEST


*CREW MODULE UPRIGHT SYSTEM TEST


ORION ENVIRONMENTAL TESTS


HEAT SHIELD BLOCK INSTALL COMPLETE


SLS BOOSTER MOTOR SEGMENTS CAST


RS-25 ENGINES PROCESSED


SLS CORE STAGE PROOFING AND WELDING


*HUMAN-IN-THE-LOOP TESTS


*DIVER RECOVERY TRAINING


ORION MISSION CONTROL SIMULATIONS


*VACUUM PRESSURE CREW TEST


PRESSURE VESSEL COMPLETE


PRESSURE VESSEL ARRIVES AT KSC


*DISPLAY AND CONTROL EVAL


ASSEMBLY, INTEGRATION, AND TESTING AT KSC

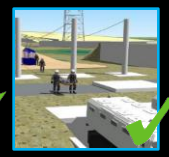

JETTISON MOTOR QUALIFIED


ATTITUDE CONTROL MOTOR QUALIFIED


SLS RL10 ENGINE COMPLETION


CREW MODULE TRAINING ARTICLE TRANSPORTED TO LETF


*EES MOCKUP EVALUATION


*PAD EMERGENCY EGRESS SYSTEM 60% DESIGN REVIEW


*EMERGENCY EGRESS SYSTEM BASKET PROTOTYPE


LH2 SPHERE


*MOBILE LAUNCHER 1 60% DESIGN REVIEW


ENVIRONMENTAL CONTROL SYSTEM CHILLERS INSTALLED


ENVIRONMENTAL CONTROL SYSTEM INFRASTRUCTURE INSTALLED


EUROPEAN SERVICE MODULE ASSEMBLY AT AIRBUS


EUROPEAN SERVICE MODULE SHIPS TO KSC


CREW MODULE ADAPTER/ EUROPEAN SERVICE MODULE MATE


CORE STAGE 2 FORWARD JOIN


CORE STAGE 2 4/5ths JOIN


CORE STAGE 2 ENGINE SECTION BREAKOVER COMPLETE


ARTEMIS I ORION N/C AVIONICS INSTALLATION IN ARTEMIS II CREW MODULE


SLS LAUNCH VEHICLE STAGE ADAPTER COMPLETION


HEAT SHIELD INSTALL ON CREW MODULE


MOBILE LAUNCHER 1 ROLL TO PAD FOR MEVV


BOOSTERS ARRIVE AT KSC


EGS BOOSTER OFFLINE PROCESSING START


SLS INTERIM CRYOGENIC PROPULSION STAGE (ICPS) READY FOR TRANSFER TO EGS


CREW MODULE COMPLETE


CREW AND SERVICE MODULE MATE

EGS OPERATIONAL READINESS CHECKPOINT

*PAD UPGRADES COMPLETE

CORE STAGE 2 READY FOR SHIPMENT TO KSC

*MOBILE LAUNCHER 1 MULTI-ELEMENT V&V AT PAD COMPLETE

*VAB ECS UPGRADES COMPLETE

*MOBILE LAUNCHER 1 MULTI-ELEMENT V&V AT VAB COMPLETE

ORION HANDOVER TO EGS

EGS ORION OFFLINE PROCESSING START

BOOSTER STACKING COMPLETE

SLS CORE STAGE, ICPS, & ADAPTERS INTEGRATION AT KSC

ORION MASS SIMULATOR MATE

ROLL TO PAD FOR TANKING TEST

ARTEMIS II TANKING TEST

ROLL TO VAB FOLLOWING TANKING TEST

ORION TO VAB

ORION INTEGRATION TO SLS

CONDUCT FINAL INTEGRATED TESTING

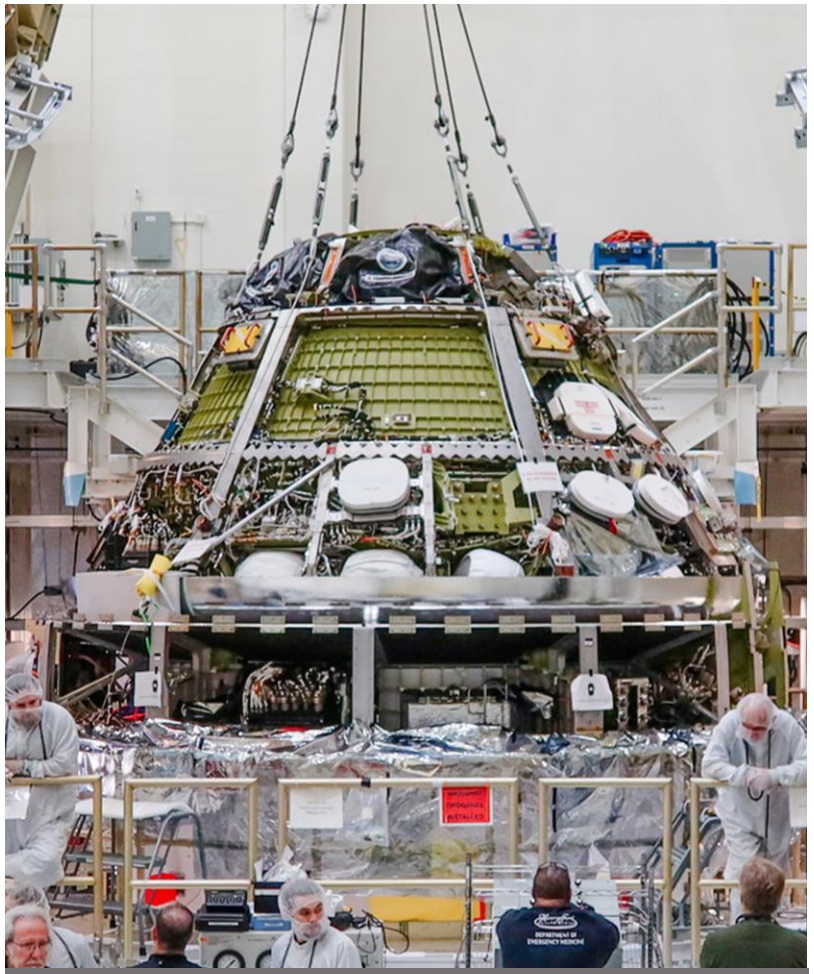
ROLL TO PAD FOR LAUNCH

ARTEMIS II LAUNCH

Unique aspect of Artemis II (* unique for crew config.)

Artemis II Progress

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

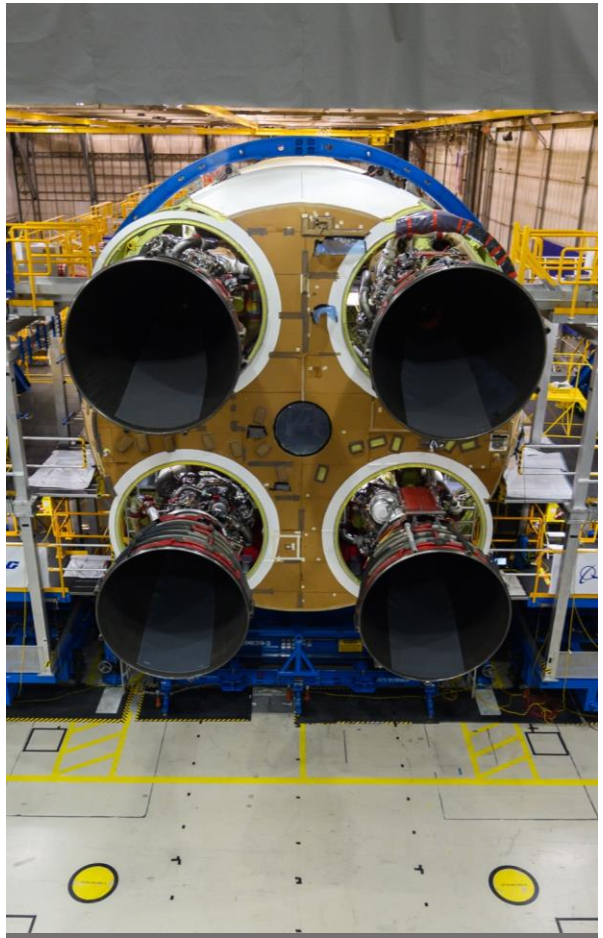


Integration of Crew and Service Modules for the Artemis II Orion Spacecraft

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

Artemis II Service Module

Artemis II Progress



All four RS-25 engines complete and installed into the Artemis II Space Launch System Rocket Core Stage

New LH2 Sphere at the Pad for Artemis II

Artemis II Spacecraft Adapter Jettison Panels at Michoud Assembly Facility

Emergency Egress System and Mobile Launcher

OSA II Flip ready for diaphragm install

Engineers and technicians perform pre-mate inspections of the right aft exit cone of the Space Launch System solid rocket boosters for the Artemis II mission inside the Rotation, Processing, and Surge Facility (RPSF)

Artemis II Progress

NASA Artemis Launch Director Charlie Blackwell-Thompson monitors activities during the Artemis II terminal countdown simulation.

The first Artemis II launch simulation inside the Firing Room at the Launch Control Center at NASA's Kennedy Space Center. The team rehearses the steps to launch Artemis II mission.

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

Artemis II crew during URT-10 Navy Diver Training at the Neutral Buoyancy Lab

Navy divers from Explosive Ordnance Disposal (EOD) Expeditionary Support Unit 1 work to secure the Orion Crew Module Test Article (CMTA) in the Pacific Ocean as part of NASA's Underway Recovery Test 10 (URT-10).

The CMTA is seen in the waters of the Pacific Ocean during NASA's URT-10.

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

Artemis II crew during URT-10 Navy Diver Training at the Neutral Buoyancy Lab

Artemis III


Artist's Concept

ARTEMIS FIRSTS:

- Human landing in South Pole region
- Orion to human landing system direct mission including crew docking activity
- Use of Near Rectilinear Halo Orbit (NRHO)
- Four astronauts to lunar orbit
- Two astronauts to lunar surface to collect scientific samples and data
- Conducting new science and technology demonstrations

NEW ELEMENTS:

- Orion full up rendezvous, proximity operations, and docking systems
- SpaceX Starship human landing system
- Axiom advanced spacesuits and tools to explore the surface and collect samples

COMMON ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1 and upgraded ground systems

Major Milestones For Artemis III

Rev. H - As of 2/15/2024

ICPS-3 ENGINE DELIVERY TO ULA

CREW MODULE ADAPTER INNER WALL DELIVERED TO O&C

CREW MODULE PRESSURE VESSEL DELIVERED TO O&C

CREW MODULE PRESSURE VESSEL PROOF TEST COMPLETED

MOTOR SEGMENTS COMPLETE

SLS INTEGRATED CRYOGENIC PROPULSION SYSTEM PRODUCTION COMPLETE

ENGINES READY FOR DELIVERY TO MAF

CONFIGURE ORION INTEGRATED TEST LAB FOR ARTEMIS III

ORION CREW MODULE ADAPTER COMPLETE

NASA DOCKING SYSTEM (NDS) COMPLETE

EUROPEAN SERVICE MODULE DELIVERY TO O&C

DOCKING MECHANISM JETTISON SYSTEM (DMJS) DELIVERY

CORE STAGE 3 INTERTANK COMPLETE

CORE STAGE 3 FWD SKIRT COMPLETE

CORE STAGE 3 LH2 TANK COMPLETE

ORION STAGE ADAPTER COMPLETE

ORION CREW MODULE READY FOR MATE

SLS LAUNCH VEHICLE STAGE ADAPTER COMPLETE

BOOSTER AFT SKIRTS COMPLETE

xEVAS PRIMARY LIFE SUPPORT SYSTEM COMPLETE

xEVAS PRESSURE GARMENT SYSTEM COMPLETE

BOOSTER FORWARD ASSEMBLY COMPLETE

CORE STAGE 3 LOX TANK COMPLETE

LAS ASSEMBLY AND TEST COMPLETE

xEVAS AI&T Complete

CORE STAGE 3 ENGINE SECTION COMPLETE

START CORE STAGE 3 FINAL MATE

ORION SERVICE MODULE READY FOR MATE

xEVAS Comm Test Complete

CREW AND SERVICE MODULE (CSM) MATE

CORE STAGE 3 COMPLETE

xEVAS HITL Vacuum Test Complete

ORION CSM DELIVERY TO EGS

START BOOSTER STACKING

ORION MPPF PROCESSING COMPLETE

EHP – xEVAS READY FOR INTEGRATION

CORE STAGE INTEGRATION

LAUNCH VEHICLE STAGE ADAPTER INTEGRATION

ICPS INTEGRATION

ORION TO VAB

ORION STAGE ADAPTER INTEGRATION

ORION INTEGRATION TO SLS COMPLETE

HLS Lunar Lander Launch

ORION SPECIFIC TESTING

CREW MODULE STOWAGE

FINAL CLOSEOUTS FOR LAUNCH & FSS

ROLL TO PAD FOR LAUNCH

EGS READY FOR ARTEMIS III LAUNCH

HLS LUNAR ORBIT CHECKOUT REVIEW (LOCR) MISSION READY

HLS Uncrewed Mission Milestones

HLS - STARSHIP/SUPER HEAVY FLIGHT TEST COMPLETE

PROPELLANT TRANSFER FLIGHT TEST COMPLETE

LONG DURATION FLIGHT TEST COMPLETE

LC-39A UPDATES

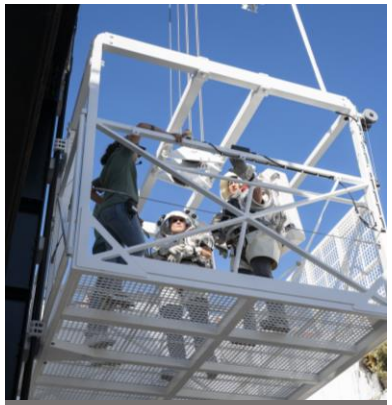
HLS UNCREWED LUNAR LANDING DEMO LAUNCH COMPLETE

SCIENCE INSTRUMENT(S) DELIVERY FOR HLS INTEGRATION

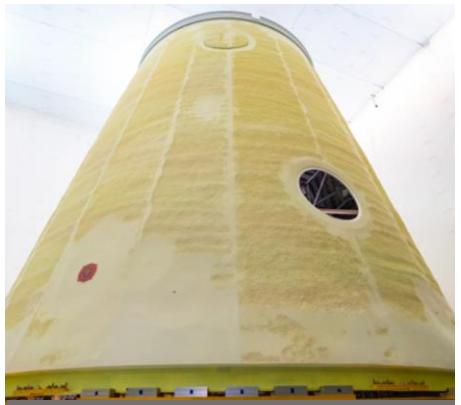
New milestones for Artemis III

Artemis III Progress

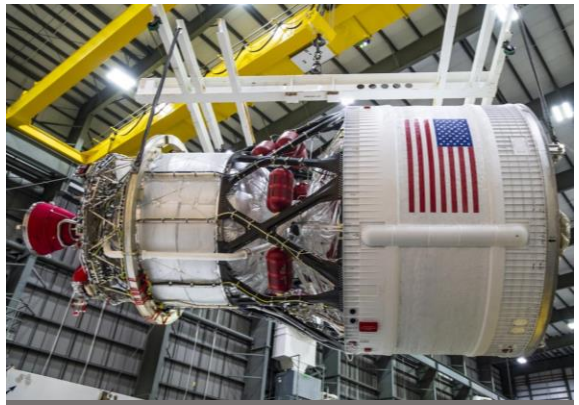
Starship second integrated flight test



Starship Human Landing System elevator astronaut testing



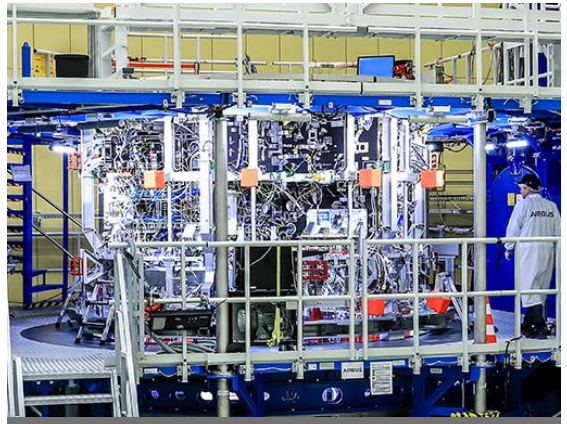
Frangible joint assembly installed onto the Launch Vehicle Stage Adapter



Artemis III Interim Cryogenic Propulsion Stage being processed

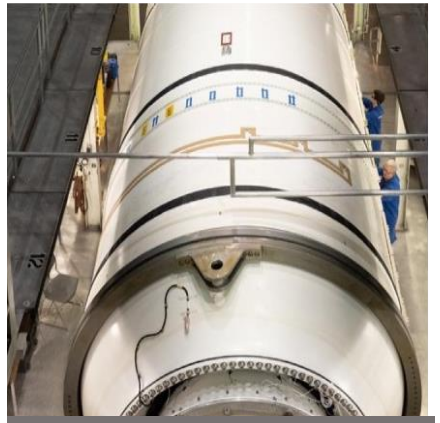
Artemis III Space Launch System Core Stage Liquid Oxygen Aft Dome

AxEMU spacesuit during testing



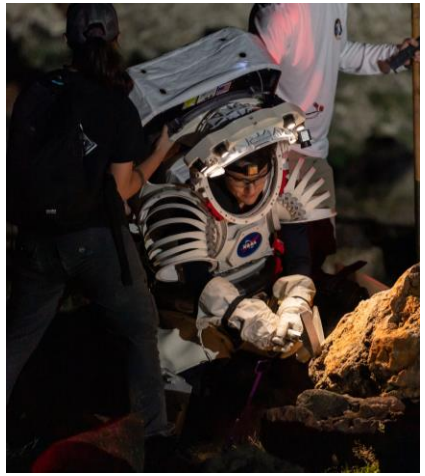
European Service Module-3 integration in Bremen cleanroom

Crew Module-3 integration

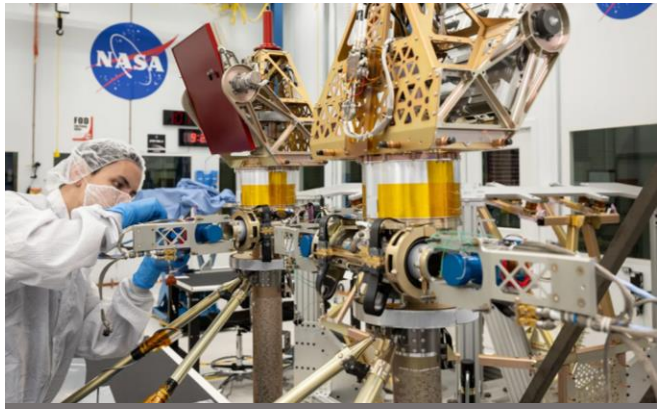


Artemis III booster segments

Artemis III Progress

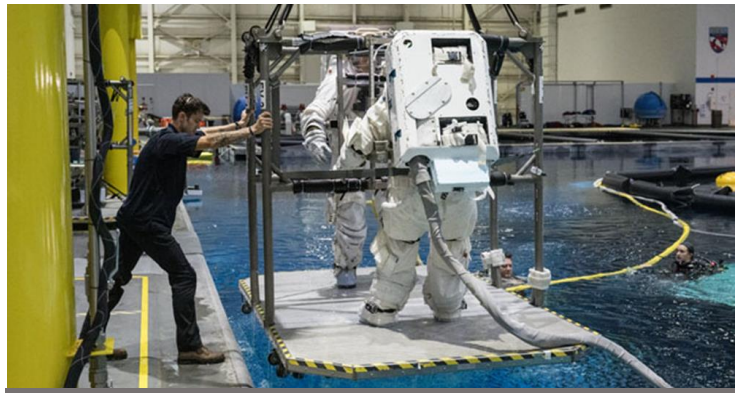


The Joint Extravehicular Activity and Human Surface Mobility Program Test Team (JETT) testing tools and spacesuits in a rock yard at NASA's Johnson Space Center in Houston, simulating the uneven terrain of the lunar surface, in preparation for Moonwalks



Engineers assemble and test NASA's first robotic Moon rover, Volatiles Investigating Polar Exploration Rover (VIPER), which will study the lunar environment to inform Artemis missions.

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



Spacesuit and EVA hardware testing in the NBL

Artemis IV


Artist's Concept

ARTEMIS FIRSTS:

- Crewed mission to Gateway space station
- Launch, delivery, and integration of a space station module in lunar orbit
- Crew transfer from Orion to human landing system (HLS) via Gateway
- Deep Space Logistics flight to Gateway
- Conducting new science and technology demonstrations

NEW ELEMENTS:

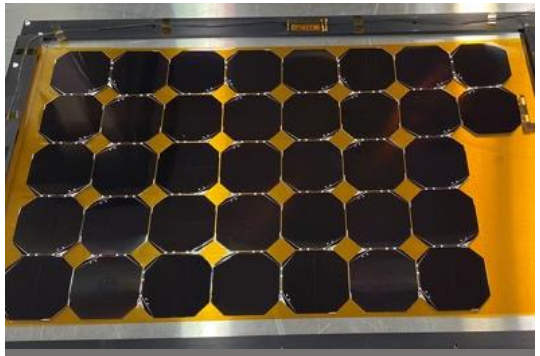
- Space Launch System rocket Block 1B configuration Mobile Launcher 2 with supporting ground systems
- SpaceX Sustaining Starship HLS
- Gateway modules: Power and Propulsion Element and Habitation and Logistics Outpost (pre-staged in orbit); International Habitat (launched on SLS Block 1B alongside the crew aboard Orion); Deep Space Logistics

COMMON ELEMENTS:

- Common SLS elements
- Orion crew spacecraft
- Spacesuits and support systems

Artemis IV Progress

Artemis IV Space Launch System Engine Section



Power and Propulsion Element (PPE) Solar Array Power Module

PPE 12-kilowatt Solar Electric Propulsion Test

The Advanced Electric Propulsion System qualification thruster

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

Artemis IV European Service Module in Bremen, Germany

Artemis IV Crew Module Pressure Vessel at Kennedy Space Center

Artemis V

Artist's Concept

ARTEMIS FIRSTS:

- Use of the lunar terrain vehicle (LTV) rover by crew to access more of the lunar surface and collect diverse scientific samples
- Use of second lunar lander design
- Use of new RS-25 engines

NEW ELEMENTS:

- Blue Moon human landing system
- LTV unpressurized rover with scientific instruments
- Gateway modules: ESPRIT Refueling Module (European System Providing Refueling Infrastructure and Telecommunications), Canadarm3 robotic arm

COMMON ELEMENTS:

- Space Launch System rocket Block 1B configuration
- Orion crew spacecraft
- Mobile Launcher 2 with supporting ground systems
- Spacesuits and support systems
- Gateway space station and Deep Space Logistics
- Conducting science and demonstrating technology in orbit and on the surface