



ESDMD Update and Outlook

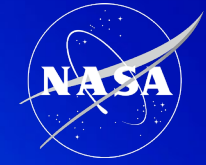


Dr. Lori Glaze

Deputy Associate Administrator (Acting)
Exploration Systems Development Mission Directorate

October 9, 2024
Aeronautics and Space Engineering Board

Moon to Mars Architecture Segments



Human Lunar Return

Initial capabilities, systems, and operations necessary to re-establish human presence and initial utilization on and around the Moon.



Foundational Exploration

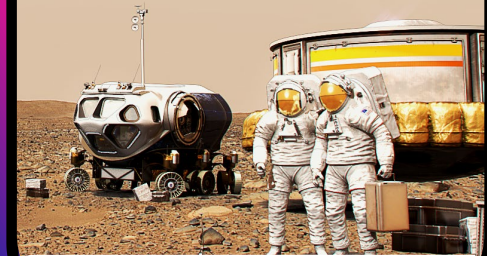
Expansion of lunar capabilities, systems, and operations supporting complex orbital and surface missions to conduct utilization and Mars forward precursor missions.



Sustained Lunar Evolution

Enabling capabilities, systems, and operations to support regional and global utilization, economic opportunity, and a steady cadence of human presence on and around the Moon.

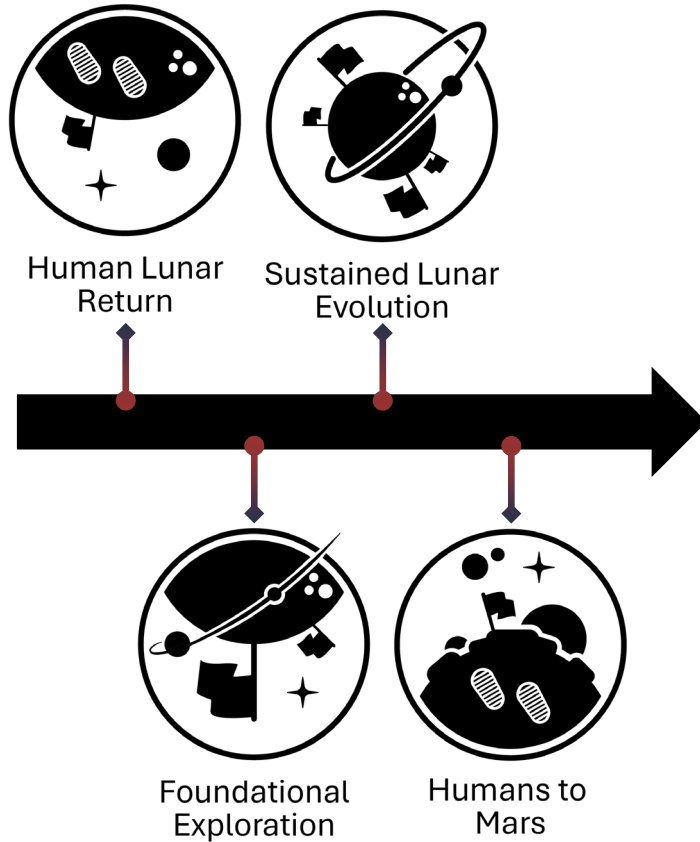
Future Segments



Humans to Mars

Initial capabilities, systems, and operations necessary to establish human presence and initial utilization on Mars and continued exploration.

Moon to Mars Architecture Segments



Segments

A portion of the architecture that integrates sub-architectures and progressively increases in complexity and objective satisfaction.



Sub-Architectures

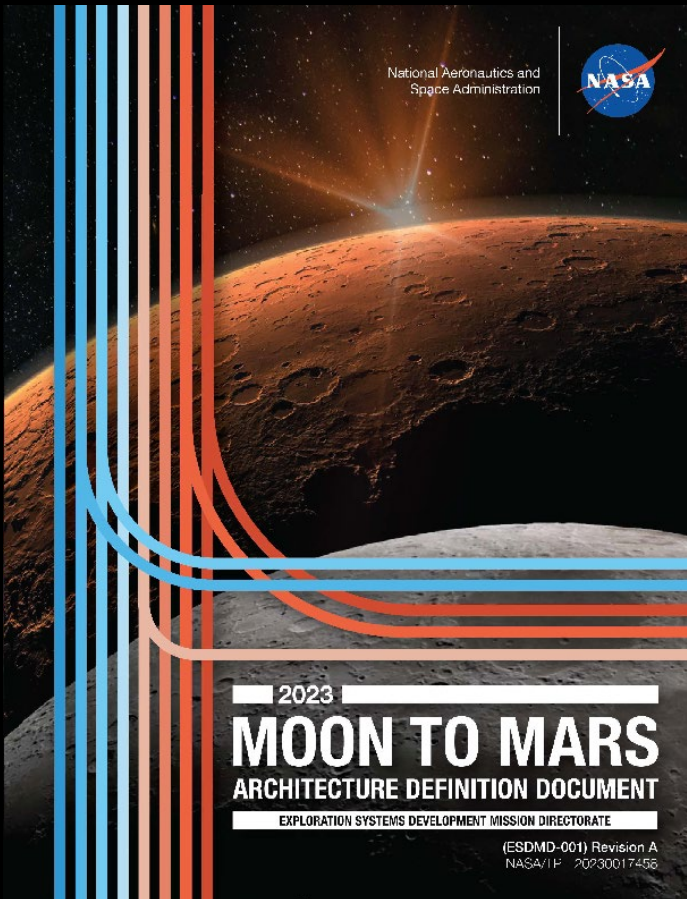
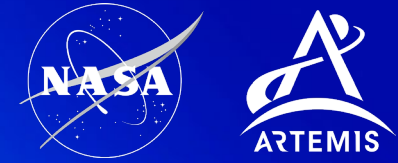
A group of tightly coupled elements, functions, and capabilities that work together to accomplish one or more objectives.



Elements

A notional exploration system that enables a set of functions.

Moon to Mars Architecture Updates



Architecture Definition Document
Revision A (ADD Rev-A)



Moon to Mars Architecture
Executive Overview



White Papers
(21 as of June 2024)

Artemis: A Foundation for Deep Space Exploration



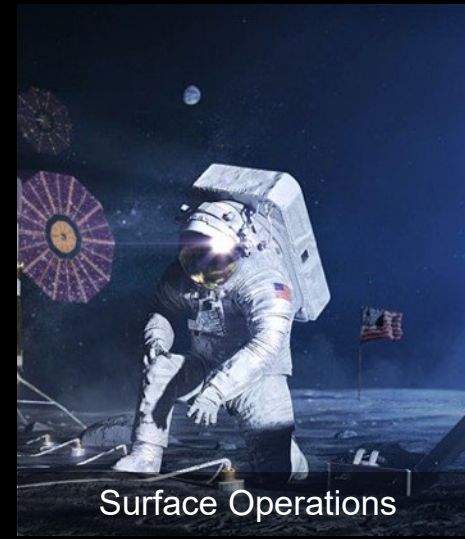
Space Launch System



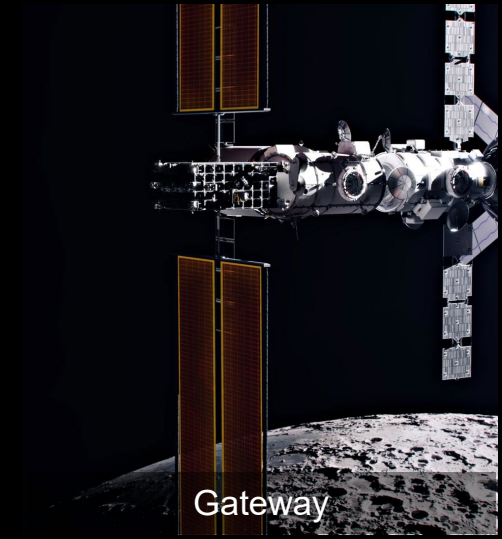
Orion Spacecraft



Human Landing System



Surface Operations



Gateway



Exploration Ground Systems



Space Communications
and Navigation



Surface Mobility



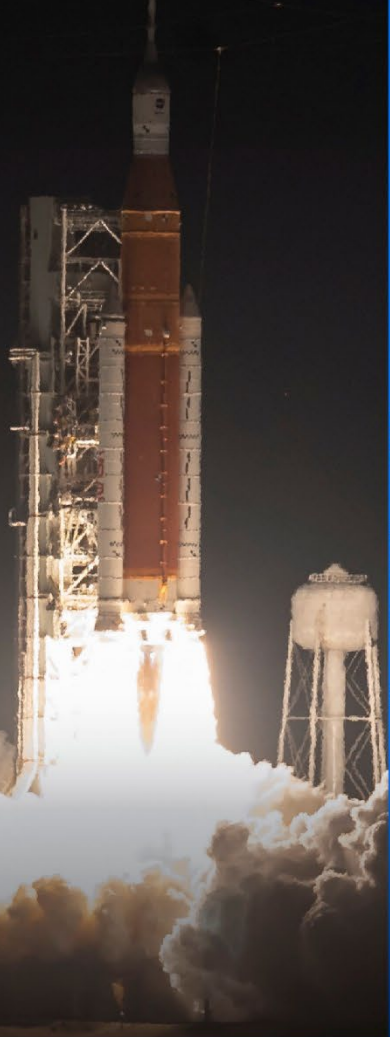
Spacesuits



Surface Infrastructure

ARTEMIS I

First Mission
(Uncrewed Flight Test)



COMPLETE

ARTEMIS II

First Crew



ARTEMIS III

First Human Surface Landing



Artist's Concept

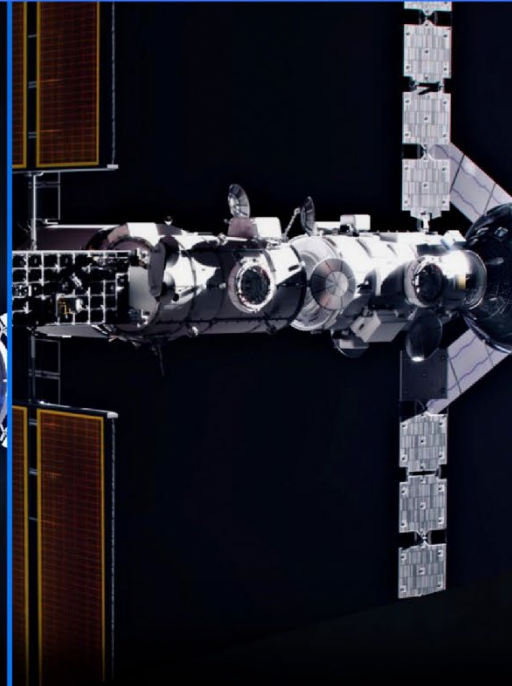


ARTEMIS IV

First Lunar Space Station
Assembly Mission



Artist's Concept

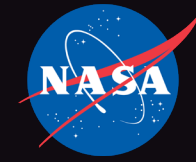


ARTEMIS V

Crewed Mobile Surface Exploration,
Gateway Expansion



Artist's Concept



Artemis II

ARTEMIS FIRSTS:

- Crewed integrated flight test of the Space Launch System (SLS) rocket, Orion spacecraft, and Exploration Ground Systems (EGS) at KSC
- Active Orion Launch Abort System (LAS)
- Demonstration of Orion life support systems
- Proximity operations demonstrations
- 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

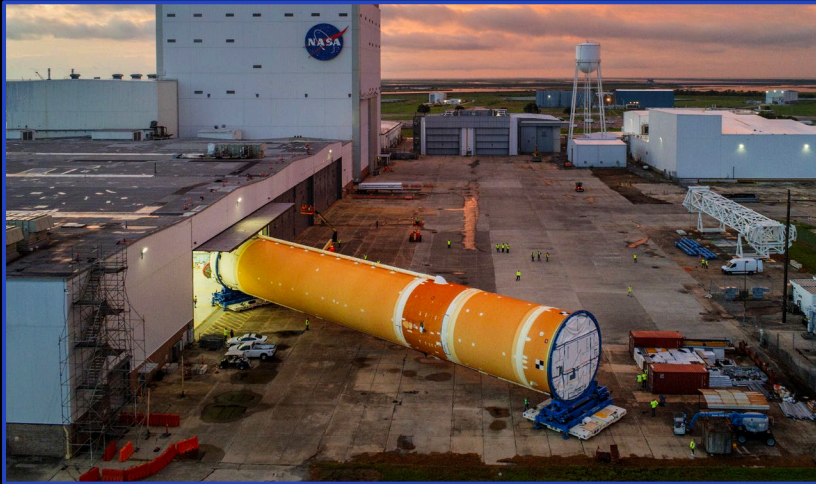
COMMON ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1

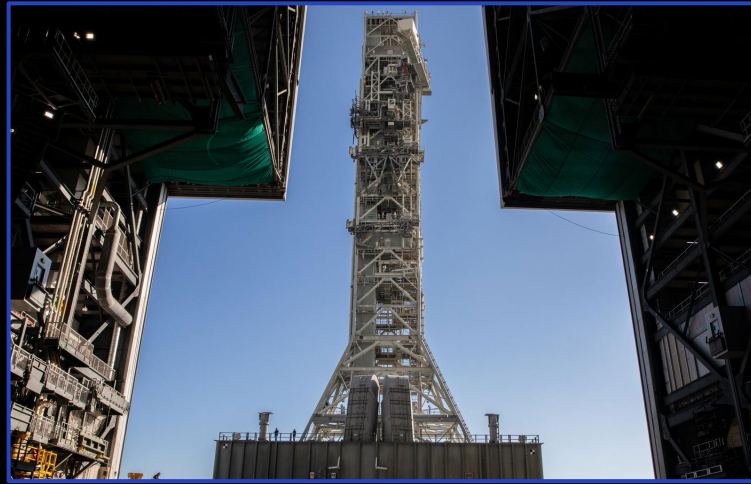
ENSURING CREW SAFETY IS OUR TOP PRIORITY!



Artemis II Progress



Artemis II core stage rollout from Michoud Assembly Facility



ML-1 Preparations for Artemis II



Artemis II Crew Practice Maneuvers Inside Orion Mock-up



Artemis II Core Stage (left) and Launch Vehicle Stage Adapter (right) at Arrive at Kennedy Space Center



EGS Teams Test Emergency Egress Baskets



Artemis II Crew Field Training in Iceland



Artemis III

ARTEMIS FIRSTS:

- Human landing in South Pole region and return
- 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:

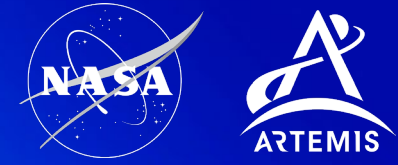
- Orion full up rendezvous, proximity operations, and docking systems
- Starship human landing system
- Advanced spacesuits and tools to explore the surface and collect samples

COMMON ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1



Artemis III Progress



Interim cryogenic propulsion stage complete final testing and checkout



SpaceX's Starship Flight Test Four



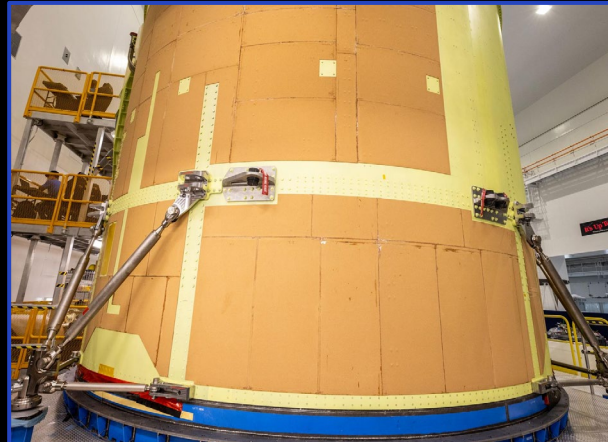
Spacesuit Test of Starship HLS



Andre Douglas (Artemis II backup astronaut), right, and Kate Rubins participate in JETT 5



Core stage liquid oxygen tank at Vertical Assembly Center at Michoud



Artemis III Core Stage Engine Section



VAB High Bay 2 Optimizing for SLS



European Service Module 3 joined with Crew Module Adapter



Artemis IV

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 science and demonstrating technology in orbit and on the surface

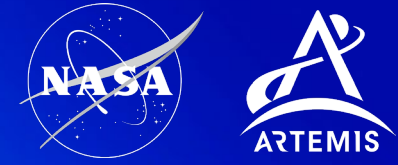
NEW ELEMENTS:

- 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

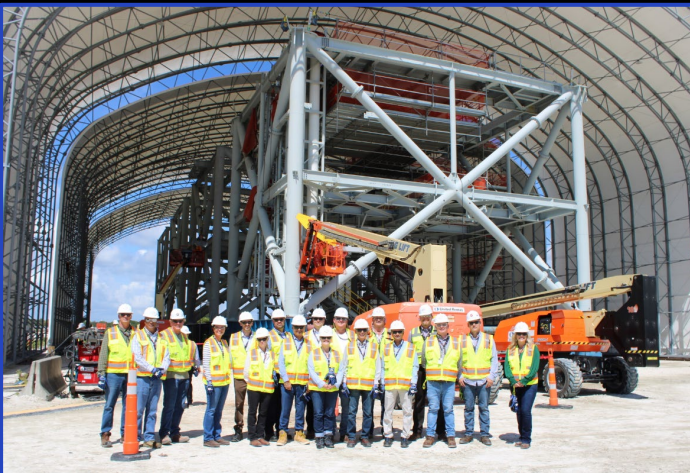
COMMON ELEMENTS:

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

Artemis IV Progress



Mobile Launcher 2 'Jack and Set' maneuver



ML2 Tower Segment as of August 30



Artemis IV Core Stage Engine Section



Liquid hydrogen tank for core stage in progress



Universal stage adapter structural qualification article panels aligned and loaded on Vertical Assembly Tool

Artemis IV: PPE/HALO Launch and Pre-staging



MISSION SUMMARY:

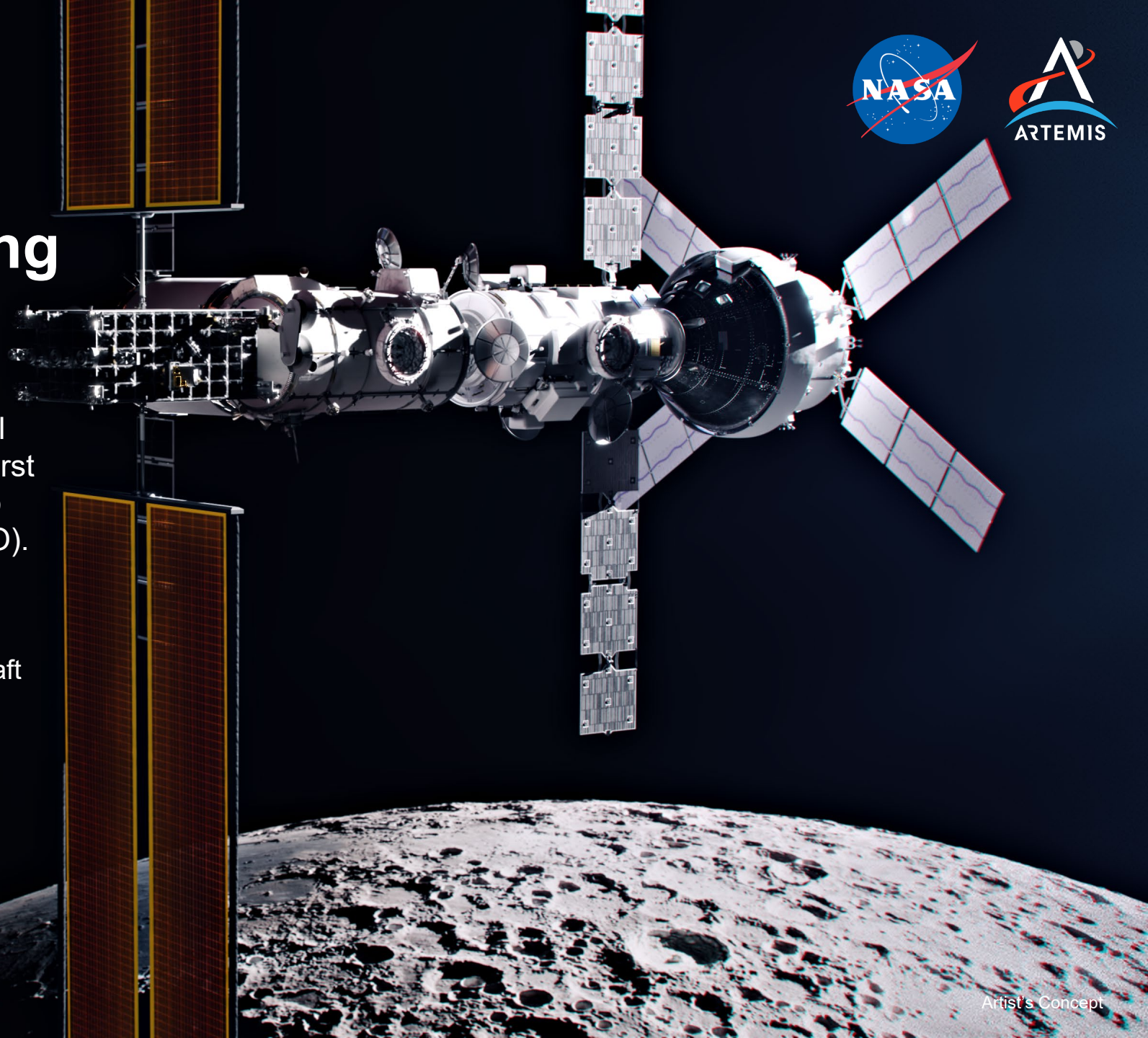
In preparation for the launch of the Artemis IV crew aboard Orion with Gateway's International Habitat module on SLS, NASA will launch the first elements of the Gateway lunar space station to the selected Near Rectilinear Halo Orbit (NRHO).

ARTEMIS FIRSTS:

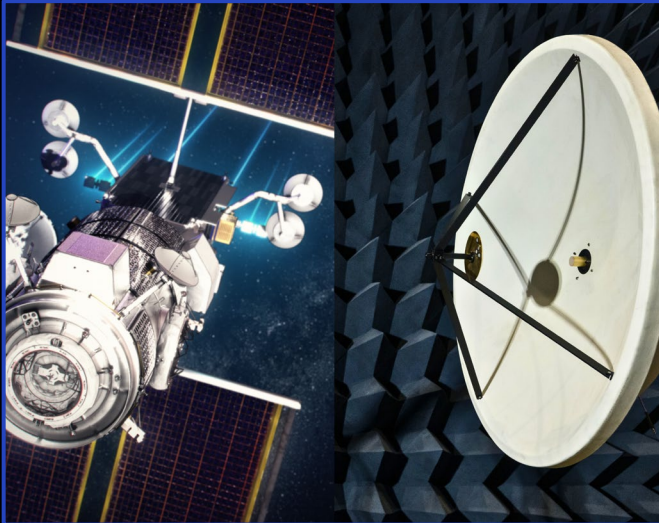
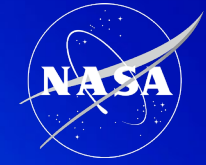
- Human habitat designed for lunar orbit
- Solar electric propulsion powered human spacecraft

NEW ELEMENTS:

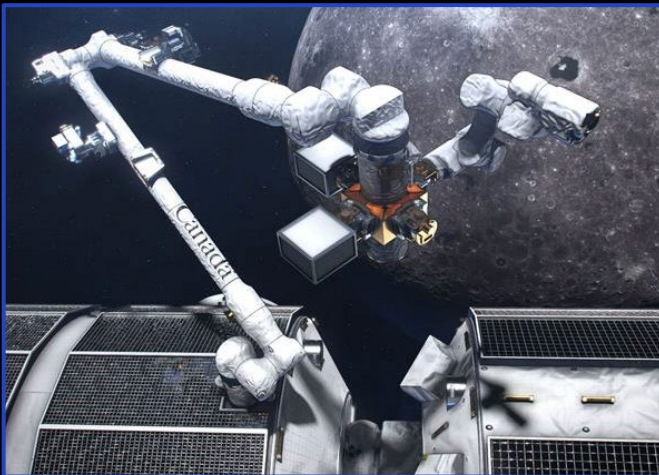
- Power and Propulsion Element (PPE)
- Habitation and Logistics Outpost (HALO)
- Science payloads to study radiation:
 - HERMES (NASA)
 - ERSA (ESA)
 - IDA (ESA, JAXA)



Gateway Progress



Field Tests for Gateway Communications



Canada began work on Canadarm3 robotic arm June 27



Maxar technicians installed xenon tanks into Power and Propulsion Element (PPE) central cylinder for Gateway



Gateway Habitation and Logistics Outpost (HALO) undergoes stress testing at Thales Alenia Space facility on June 10



NASA astronaut Nicole Mann participates in virtual reality testing of Gateway



Artemis V

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
- Conducting new science and demonstrating technology in orbit and on the surface

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

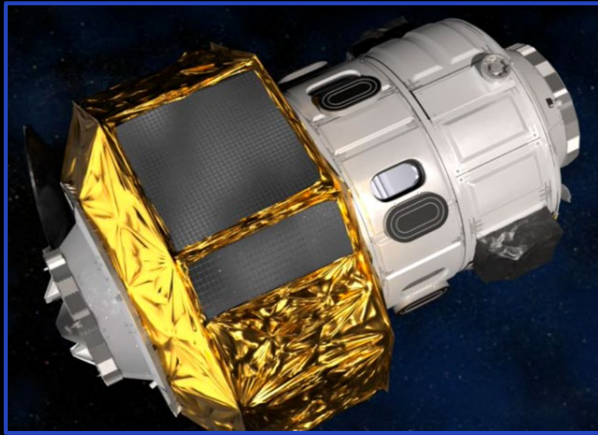
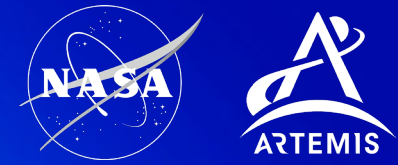
COMMON ELEMENTS:

- Space Launch System rocket Block 1B configuration
- Orion crew spacecraft
- Mobile Launcher 2 with supporting ground systems
- Spacesuits and support systems



Artist's Concept

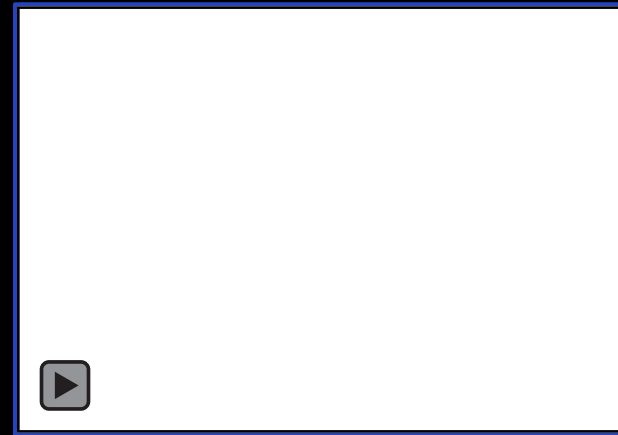
Artemis V and Beyond



ESA Lunar View Refueling Module will transport cargo and provide storage, fuel



Japan Pressurized Rover



Trial BOLE Composite Case Winding



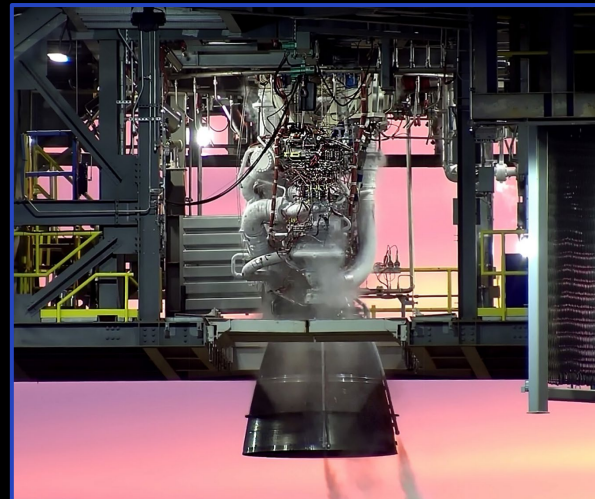
Artist's concept of Intuitive Machines' Moon RACER LTV. Credit: Intuitive Machines



Artist's concept of Lunar Outpost's Lunar Dawn LTV. Credit: Lunar Outpost



Artist concept of Blue Origin's Blue Moon human landing system



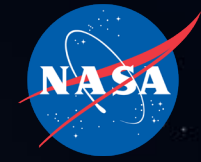
BE-7 Engine for Blue Moon Landers



Blue Origin's Marine Landing Platform



Artist's concept of Venturi Astrolab's FLEX LTV. Credit: Astrolab



We came in peace.



We return for all humanity.



Q&A

