National Aeronautics and Space Administration

Artemis I-III: Mission Overview & Systems Architecture

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We’re going to the Moon

to learn to live on other planets,
for the benefit of all humanity.

With Artemis, NASA will put the first woman and first person of color on the lunar surface, build a long-term presence there and in lunar orbit, and make new scientific discoveries about our solar system.

NASA Astronaut Tracy Caldwell Dyson

Why the Moon?

Exploring the Moon leads to new discoveries and returns incredible value to humanity

- Establish leadership and strategic presence
- Inspires a new generation and builds careers in STEM
- Advances civilization by revolutionizing science and technology
- Creates opportunity and economic growth
- Prove technology and capabilities for sending humans to Mars

Apollo 12 Lunar Module

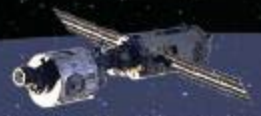
Evolving Habitation Systems for SUSTAINABLE HUMAN EXPLORATION

Use ISS as Testbed for Evolution of ECLSS and CHPS

International Space Station (ISS)

- Demonstrate new capabilities
- Increase reliability data of existing capabilities

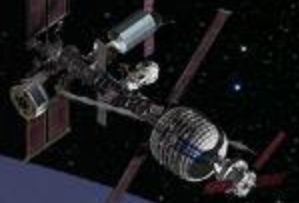
Continue Testbeds on Commercial Platforms in LEO



Notional Commercial Platform in LEO

Infuse Technologies into Gateway

Orion and Gateway



- Toilet
- CO_2
- Environmental monitoring
- Low-mass exercise countermeasure
- Radiation monitoring
- Medical system
- Fire suppression and cleanup
- Dormancy/autonomy

Infuse Full Long Duration Microgravity ECLSS and CHPS into Mars Transport

Mars-class Transportation

- High-reliability and high loop closure ECLSS
- Broad spectrum environmental monitoring
- Long shelf-life, low water food system
- Countermeasures to support self-egress
- Medical diagnostics, treatment, and decision support

Complementary Ground Tests and Analogs

- Food system analog to evaluate crew impacts
- Integrated reliability testing
- Partial gravity drop tower and suborbital flight material flammability evaluations
- CHPS integrated analogs

Human Landing System and Sustained Lunar Surface ECLSS-CHP Infusion

- Partial gravity and exploration atmosphere fire safety
- Exploration spacewalk pre-breathe and conops
- Surface habitat: regenerative ECLSS and CHPS adapted for surface
- Pressurized rover: ECLSS waste collection and transfer

Mars Surface ECLSS-CHPS

- Robust microbial and chemical monitoring
- Planetary protection compatible surface waste disposal

ECLSS = Environmental Control and Life Support Systems | CHPS = Crew Health and Performance Systems | LEO = Low-Earth Orbit

GRAPHICS NOT TO SCALE 20220513

Image Credit: Andrew McCarthy

What is Artemis?

- Global Community on Earth, in Low-Earth Orbit, and in the Lunar Environment
- Space Launch System Rocket
- Orion Crew Spacecraft
- Exploration Ground Systems
- Commercial Lunar Payload Services
- First Woman and First Person of Color on the Lunar Surface
- Gateway in Lunar Orbit
- Artemis Base Camp

Artemis: A Foundation for Deep Space Exploration


Space Launch System


Orion spacecraft

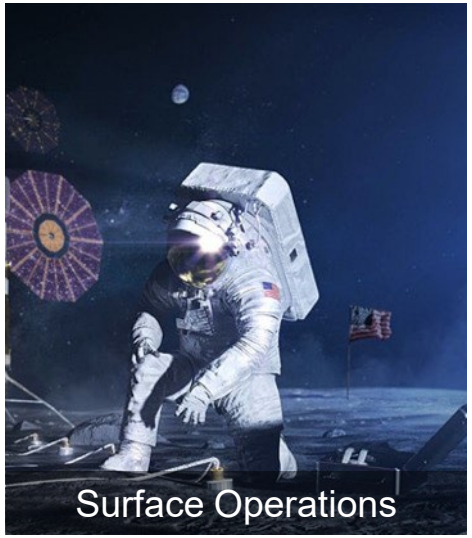
Exploration Ground Systems


Human Landing System


Space Communications & Navigation


Spacesuits


Gateway


Surface Operations

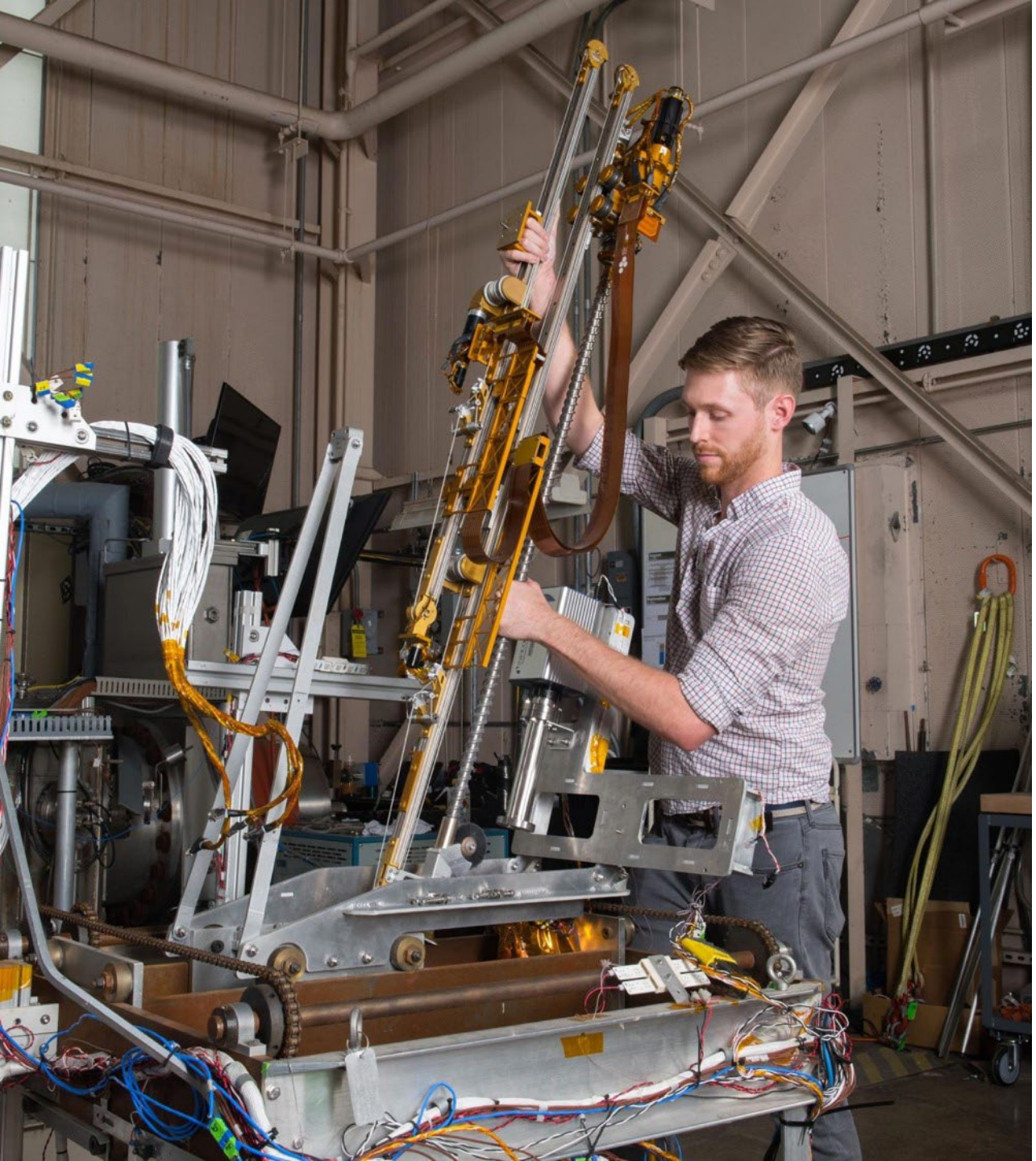

Surface Mobility


Artemis Base Camp

Artemis Science Objectives

- Understand planetary processes
- Understand the character and origin of lunar polar volatiles
- Interpret impact history of Earth-Moon system
- Reveal the record of the ancient sun and our astronomical environment
- Observe the universe and the local space environment from a unique location
- Conduct experimental science in the lunar environment
- Investigate and mitigate exploration risks

Pictured left: NASA astronaut candidates and field instructors hike during geology training in Arizona



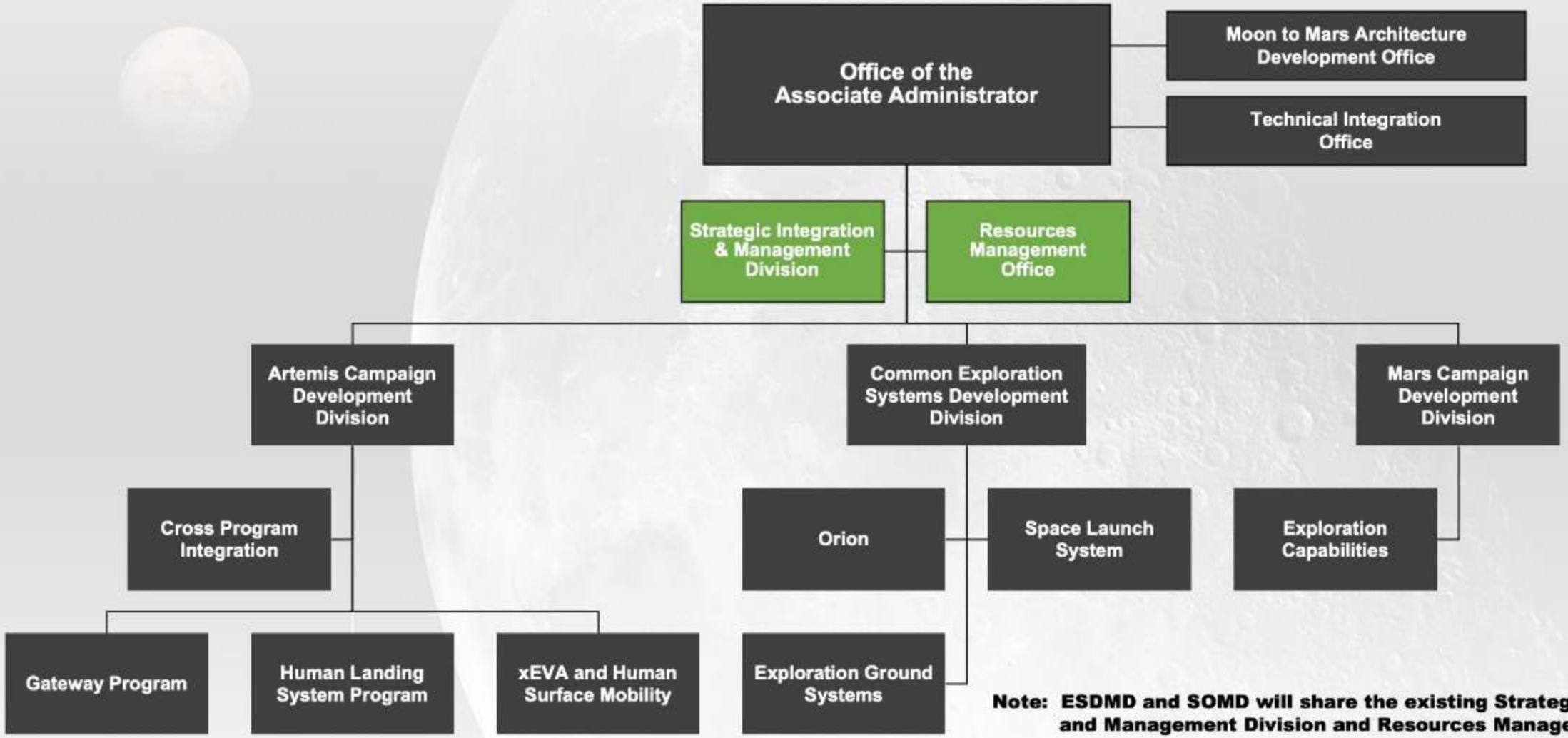
Artemis Technology Objectives

The **Lunar Surface Innovation Initiative (LSII)** works across industry, academia and government through in-house efforts and public-private partnerships to develop transformative capabilities like:

- In-situ resource utilization (ISRU)
- Surface power
- Dust mitigation
- Extreme environment
- Extreme access
- Excavation and construction

Pictured left: A Honeybee Robotics systems engineer installs The Regolith and Ice Drill for Exploring New Terrain (TRIDENT) on a trolley for thermal vacuum chamber testing. TRIDENT will drill up to three feet deep, extracting lunar soil and demonstrating a critical capability for future ISRU.

EXPLORATION SYSTEMS DEVELOPMENT MISSION DIRECTORATE



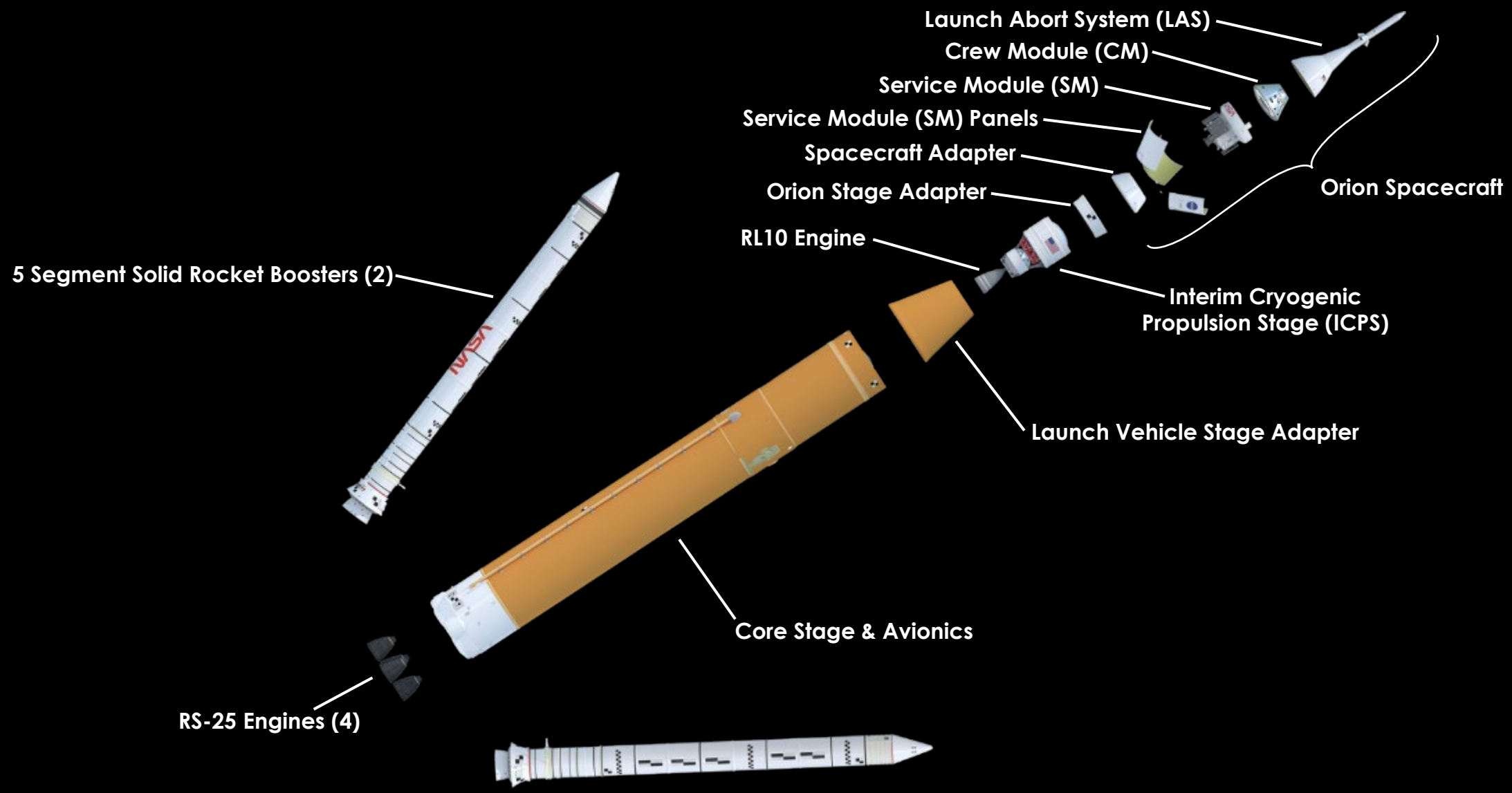
Note: ESDMD and SOMD will share the existing Strategic Integration and Management Division and Resources Management Office

ARTEMIS I

The First Uncrewed Integrated Flight Test of NASA's Orion Spacecraft and Space Launch System Rocket

1. **LAUNCH**
   SLS and Orion lift off from pad 39B at Kennedy Space Center.
2. **JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**
3. **CORE STAGE MAIN ENGINE CUT OFF**
   With separation.
4. **PERIGEE RAISE MANEUVER**
5. **EARTH ORBIT**
   Systems check with solar panel adjustments.
6. **TRANS LUNAR INJECTION (TLI) BURN**
   Maneuver lasts for approximately 20 minutes.
7. **INTERIM CRYOGENIC PROPULSION STAGE (ICPS) SEPARATION AND DISPOSAL**
   ICPS commits Orion to moon at TLI.
8. **OUTBOUND TRAJECTORY CORRECTION (OTC) BURNS**
   As necessary adjust trajectory for lunar flyby to Distant Retrograde Orbit (DRO).
9. **OUTBOUND POWERED FLYBY (OPF)**
   60 nmi from the Moon; targets DRO insertion.
10. **LUNAR ORBIT INSERTION**
    Enter Distant Retrograde Orbit.
11. **DISTANT RETROGRADE ORBIT**
    Perform half or one and a half revolutions in the orbit period 38,000 nmi from the surface of the Moon.
12. **DRO DEPARTURE**
    Leave DRO and start return to Earth.
13. **RETURN POWERED FLYBY (RPF)**
    RPF burn prep and return coast to Earth initiated.
14. **RETURN TRANSIT**
    Return Trajectory Correction (RTC) burns as necessary to aim for Earth's atmosphere.
15. **CREW MODULE SEPARATION FROM SERVICE MODULE**
16. **ENTRY INTERFACE (EI)**
    Enter Earth's atmosphere.
17. **SPLASHDOWN**
    Pacific Ocean landing within view of the U.S. Navy recovery ship.

ARTEMIS I VEHICLE OVERVIEW



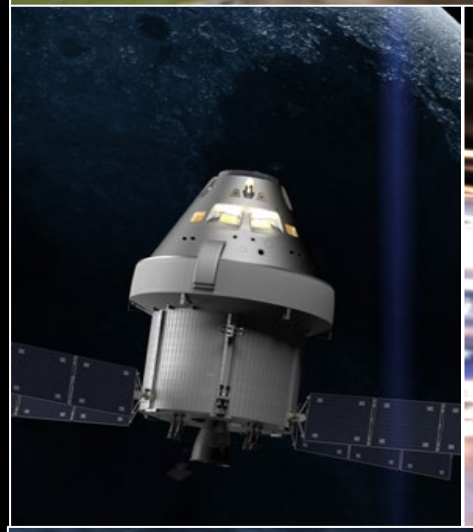
ARTEMIS I

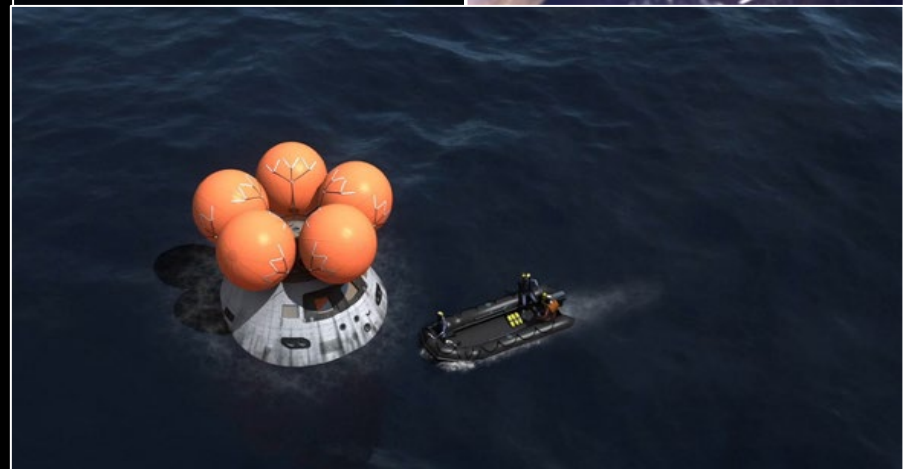
FLIGHT TEST PRIORITIES

A flight test that will enable NASA to fly crew to the Moon and back on Artemis II:

1. **Demonstrate Orion heatshield at lunar re-entry conditions**
2. **Operate Systems in Flight Environment**
3. **Retrieve Spacecraft**
4. **Complete Remaining Objectives**

   Perform residual mission in the absence of system failures and conduct all mission content as planned





Artemis I Payloads

Science and technology investigations and demonstrations paving the way for future, deep space human exploration

Moonikin Campos

The Moonikin is a male-bodied manikin previously used in Orion vibration tests. Campos will occupy the commander's seat inside and wear an Orion Crew Survival System suit

Radiation Sensors
There will be three types of sensors, including the ESA Active Dosimeters, Hybrid Electronic Radiation Assessor, and the Radiation Area Monitor.

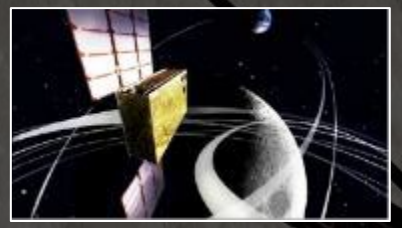
MARE
Radiation shielding Personal Protection Equipment (radiation vest) for astronauts.

Crew Interface Technology Payload (CITP)
Creates an interactive experience between Orion and the public during the mission

Bio-Experiment-1
Battery-powered life sciences payload for biology research beyond low-Earth orbit (LEO)

ArgoMoon

LunaH-Map



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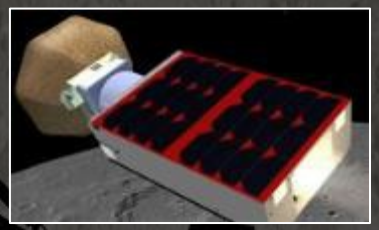
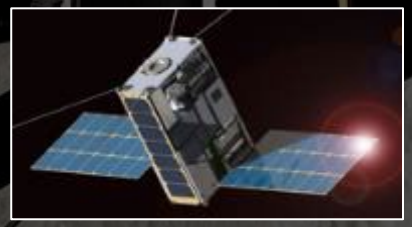


OMOTENASHI

LunIR

Near-Earth Asteroid Scout (NEA Scout)

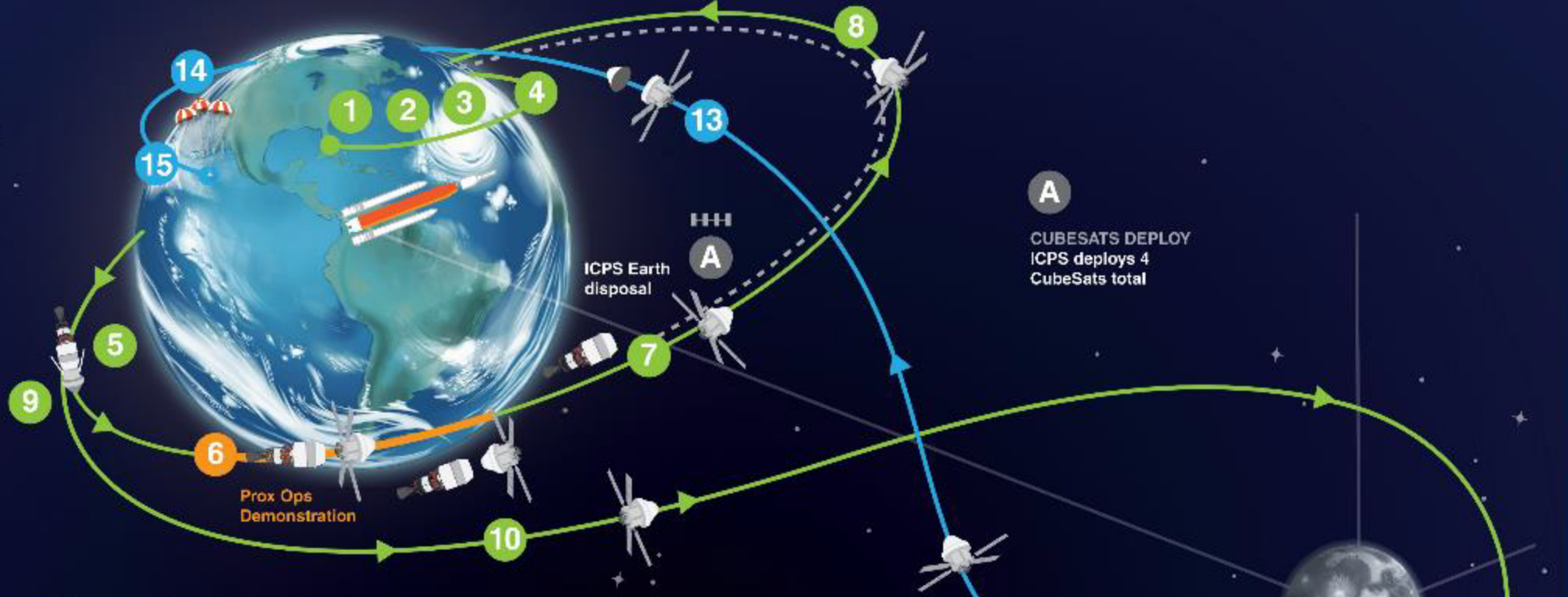


Lunar IceCube

BioSentinel

Team Miles

CuSP



ARTEMIS II

First Crewed Test Flight to the Moon Since Apollo

1 LAUNCH
Astronauts lift off from pad 39B at Kennedy Space Center.

2 JETTISON SOLID ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM

3 CORE STAGE MAIN ENGINE CUT OFF
With separation.

4 PERIGEE RAISE MANEUVER

5 APOGEE RAISE BURN TO HIGH EARTH ORBIT
Begin 24 hour checkout of spacecraft.

6 ORION SEPARATION FROM INTERIM CRYOGENIC PROPULSION STAGE (ICPS) FOLLOWED BY PROX OPS DEMO
Plus manual handling qualities assessment for up to 2 hours.

7 ORION UPPER STAGE SEPARATION (USS) BURN
Begins high Earth orbit checkout. Life support, exercise, and habitation equipment evaluations.

8 PERIGEE RAISE BURN

9 TRANS-LUNAR INJECTION (TLI) BY ORION'S MAIN ENGINE
Lunar free return trajectory initiated with European service module.

10 OUTBOUND TRANSIT TO MOON
4 days outbound transit along free return trajectory.

11 LUNAR FLYBY
5,630 nmi (mean) lunar farside altitude.

12 TRANS-EARTH RETURN
Return Trajectory Correction (RTC) burns as necessary to aim for Earth's atmosphere; travel time approximately 4 days.

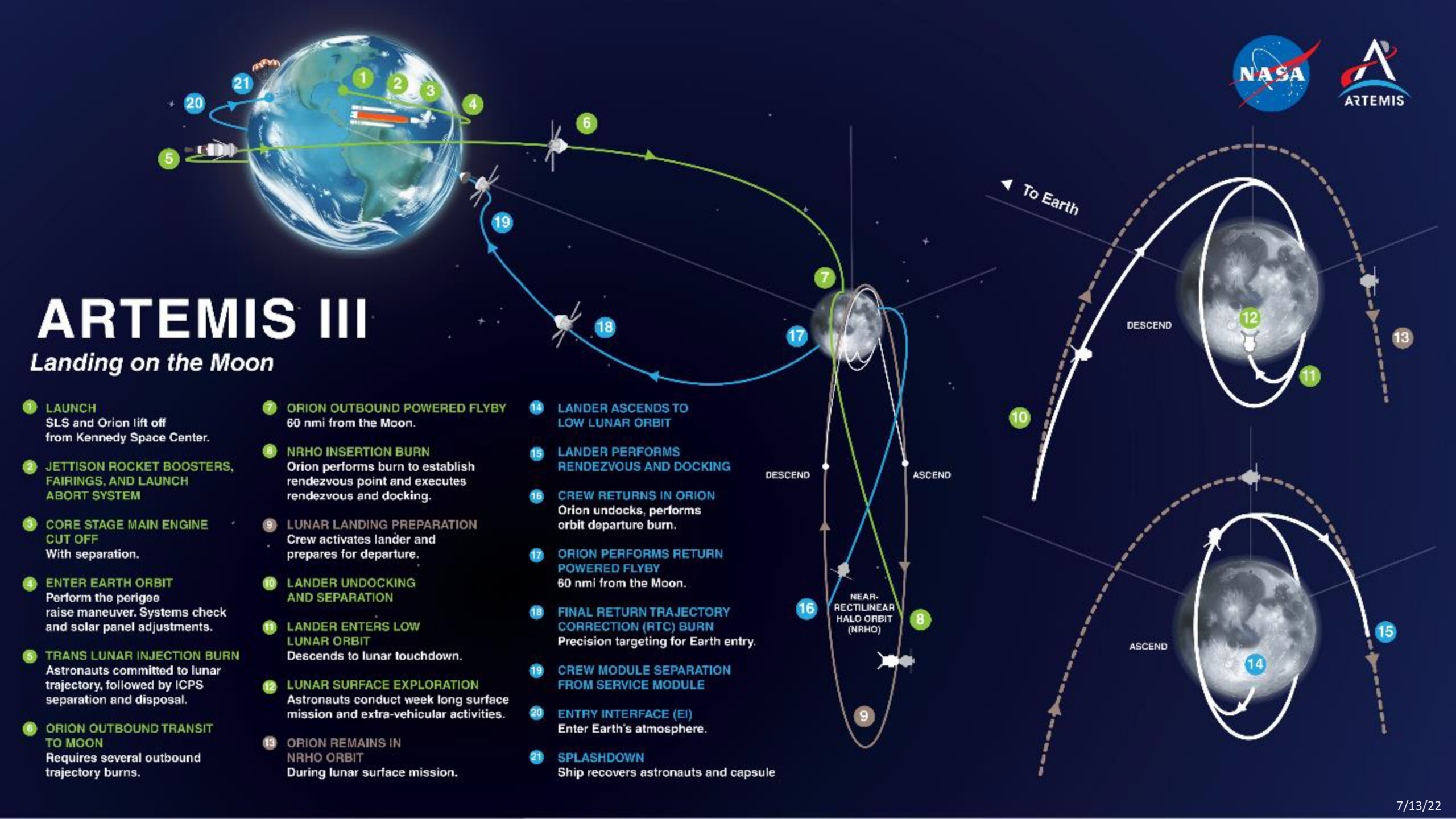
13 CREW MODULE SEPARATION FROM SERVICE MODULE

14 ENTRY INTERFACE (EI)
Enter Earth's atmosphere.

15 SPLASHDOWN
Ship recovers astronauts and capsule.

A CUBESATS DEPLOY
ICPS deploys 4 CubeSats total

10/11/22


NASA
ARTEMIS
ARTEMIS III
Landing on the Moon
1 LAUNCH
SLS and Orion lift off from Kennedy Space Center.
2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM
3 CORE STAGE MAIN ENGINE CUT OFF
With separation.
4 ENTER EARTH ORBIT
Perform the perigee raise maneuver. Systems check and solar panel adjustments.
5 TRANS LUNAR INJECTION BURN
Astronauts committed to lunar trajectory, followed by ICPS separation and disposal.
6 ORION OUTBOUND TRANSIT TO MOON
Requires several outbound trajectory burns.
7 ORION OUTBOUND POWERED FLYBY
60 nmi from the Moon.
8 NRHO INSERTION BURN
Orion performs burn to establish rendezvous point and executes rendezvous and docking.
9 LUNAR LANDING PREPARATION
Crew activates lander and prepares for departure.
10 LANDER UNDOCKING AND SEPARATION
11 LANDER ENTERS LOW LUNAR ORBIT
Descends to lunar touchdown.
12 LUNAR SURFACE EXPLORATION
Astronauts conduct week long surface mission and extra-vehicular activities.
13 ORION REMAINS IN NRHO ORBIT
During lunar surface mission.
14 LANDER ASCENDS TO LOW LUNAR ORBIT
15 LANDER PERFORMS RENDEZVOUS AND DOCKING
16 CREW RETURNS IN ORION
Orion undocks, performs orbit departure burn.
17 ORION PERFORMS RETURN POWERED FLYBY
60 nmi from the Moon.
18 FINAL RETURN TRAJECTORY CORRECTION (RTC) BURN
Precision targeting for Earth entry.
19 CREW MODULE SEPARATION FROM SERVICE MODULE
20 ENTRY INTERFACE (EI)
Enter Earth's atmosphere.
21 SPLASHDOWN
Ship recovers astronauts and capsule
To Earth
DESCEND
ASCEND
NEAR-RECTILINEAR HALO ORBIT (NRHO)

Space Launch System

S L S

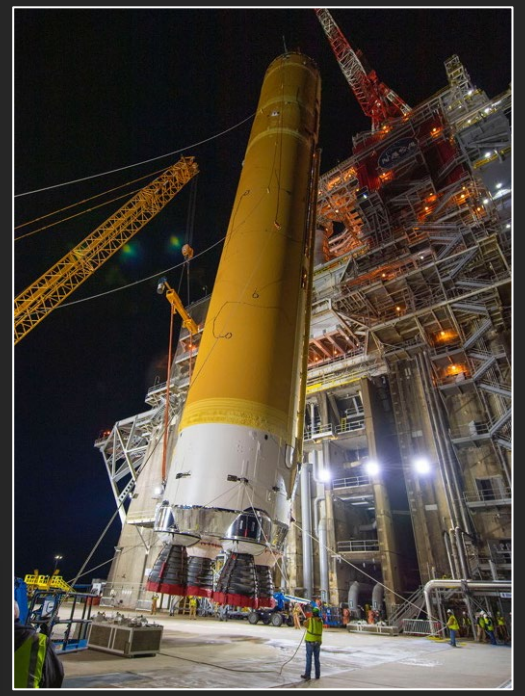
BOOSTER

Together, the SLS twin boosters provide more than 75 percent of the total SLS thrust for two minutes at launch.

ENGINES

Each of the RS-25 engines produces more than 500,000 lbs thrust for the 8 minute climb to space.

CORE STAGE

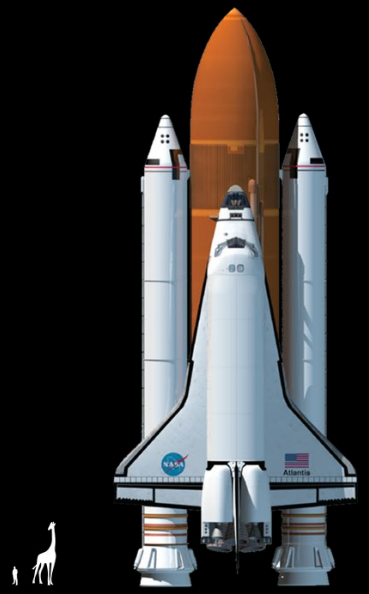


The core stage holds the hydrogen and oxygen propellant tanks and the avionics.

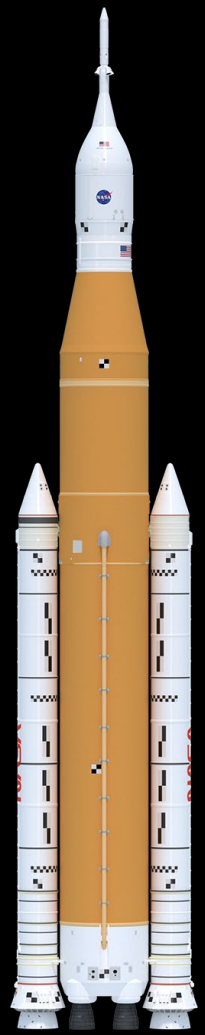
UPPER STAGE & ADAPTERS

The upper stage provides in-space propulsion with one RL10 engine. Two adapters connect elements and finish the SLS stack.

STATUE OF LIBERTY
305 ft.



SPACE SHUTTLE
184 ft.

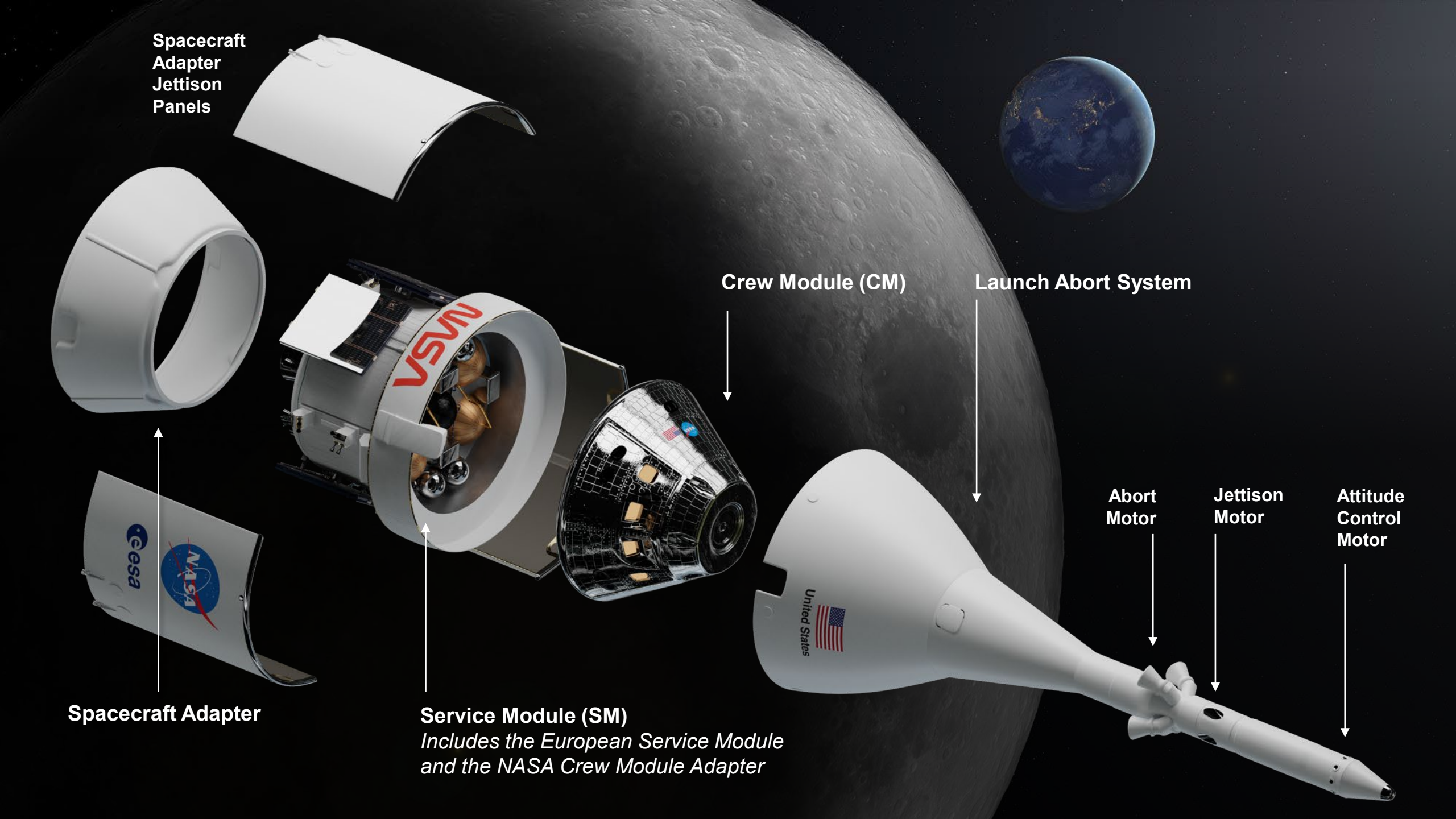


SLS / ORION Block I
322 ft.

SLS / ORION Block II
364 ft.

SATURN 5
363 ft.


ORION


Spacecraft Adapter Jettison Panels
Crew Module (CM)
Launch Abort System
Abort Motor
Jettison Motor
Attitude Control Motor
Spacecraft Adapter
Service Module (SM)
Includes the European Service Module and the NASA Crew Module Adapter

Exploration Ground Systems

E G S

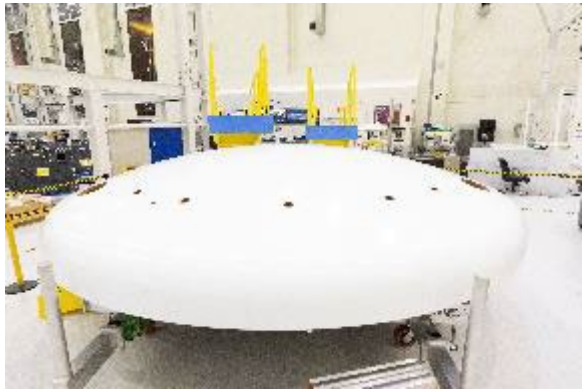

NASA


ARTEMIS


NASA

Artemis II Progress

CM ECLSS Bay Components Installed



Heatshield Thermal Test Complete

CMA/ESM Mate

CM Prop & ECLSS Tanks Installed and Welded

Artemis II Slide Hatch in Acceptance Testing

Artemis II LAS 0 Degree Ogive in Protoqual Testing

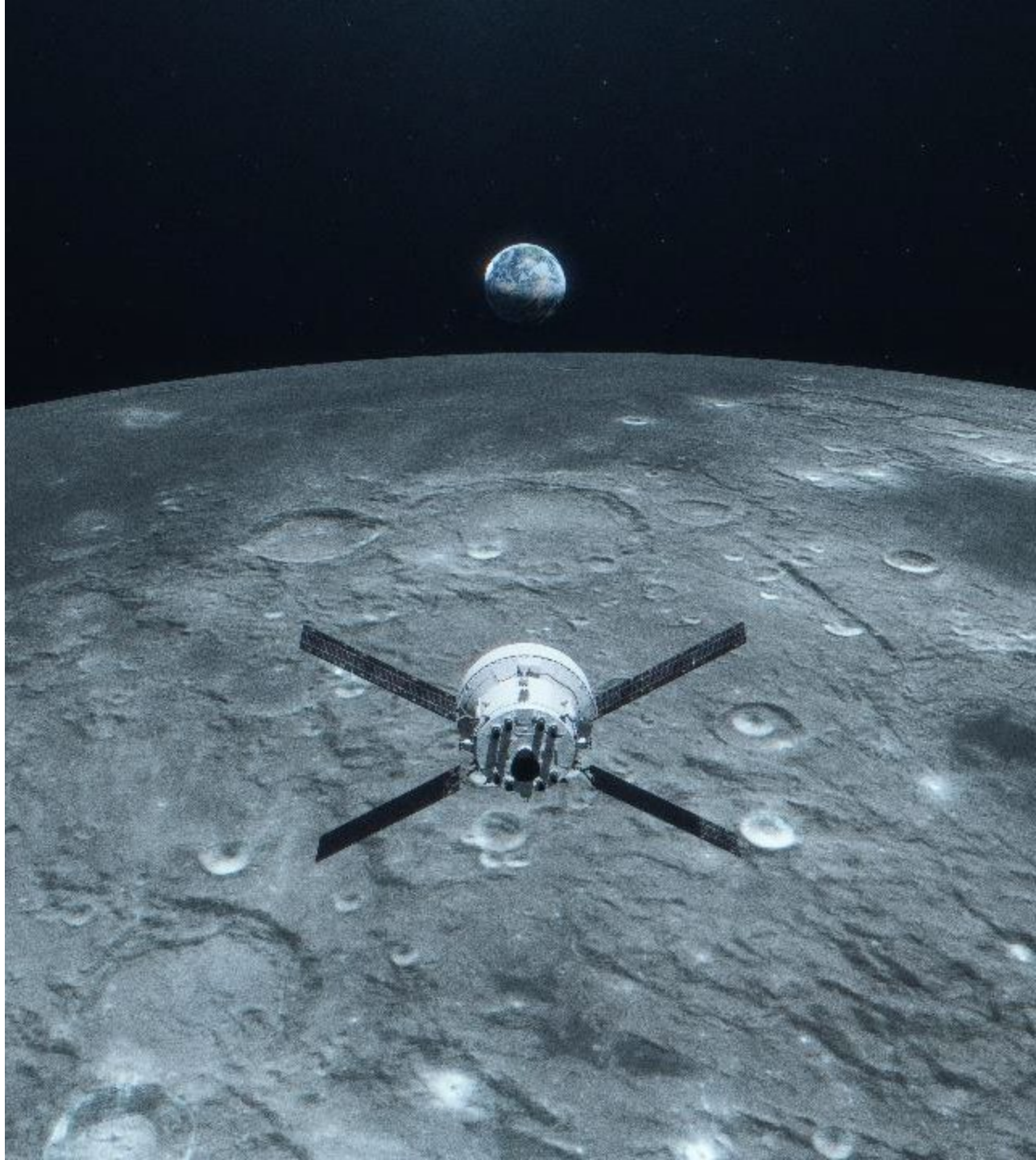
Artemis II LAS Hatch Completing Production

Forward Bay Cover Tile & FRSI Bonding Complete

Artemis II Mission Highlights:

First crewed flight of SLS and Orion

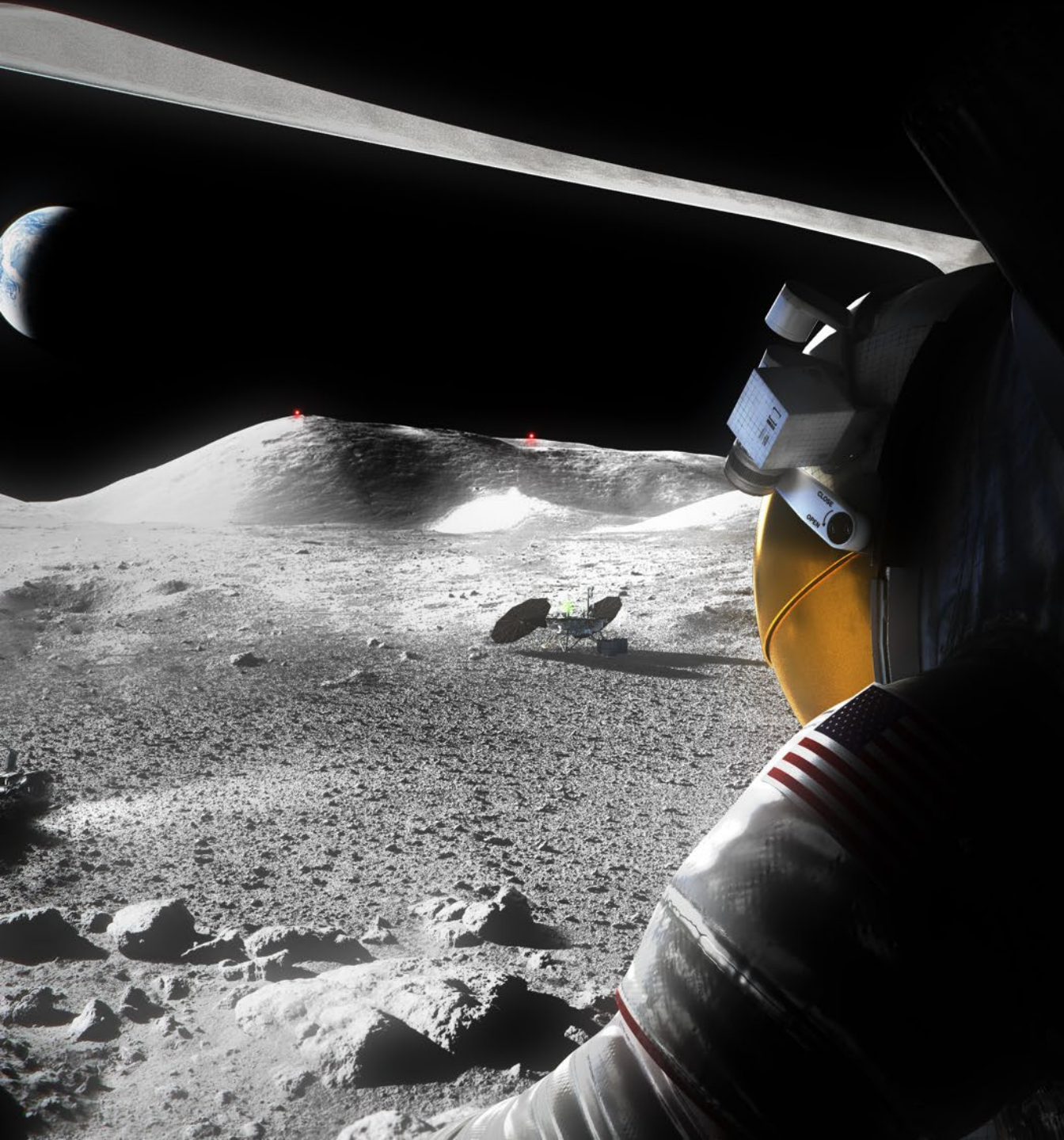
- Fly up to four astronauts to cislunar space for the first time in more than 50 years
- Return the crew safely after the mission
- Perform a lunar flyby
- Perform rendezvous and proximity operations
- Retrieve spacecraft



Artemis III Highlights:

First woman on the Moon

- First humans on the Moon’s South Pole
- Return the crew safely home after the mission
- First moonwalk in more than 50 years
  - Rock and soil samples
  - Atmosphere samples
  - Geological data
  - Photos and videos
- Retrieve spacecraft



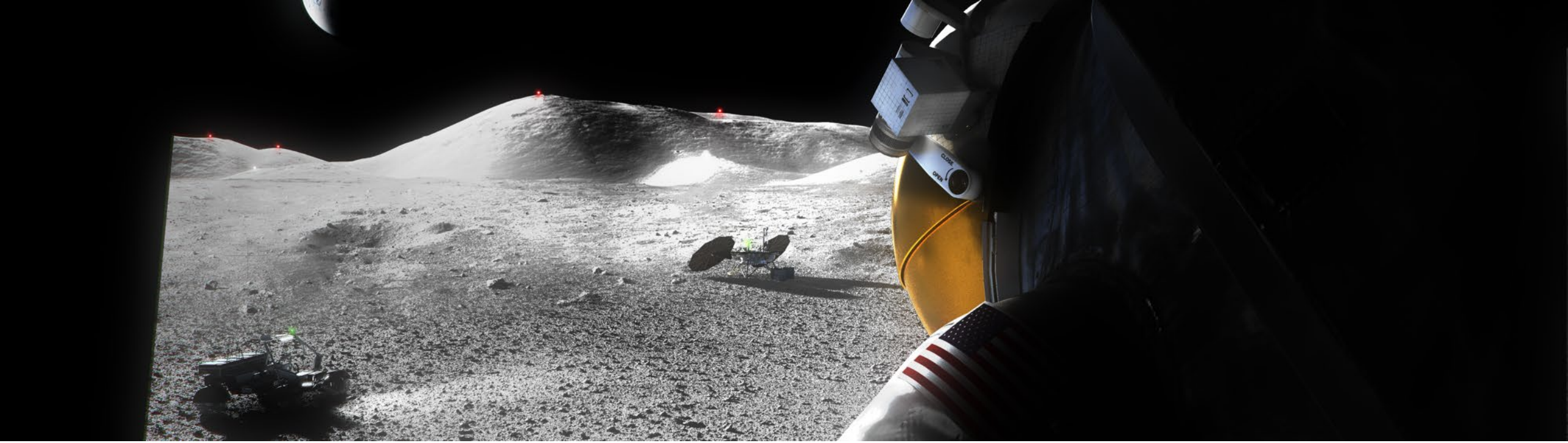
Human Landing System

HLS

Sustaining Lunar Transport

Using proven commercial partnership strategies, NASA is working with U.S. industry to build towards regular human lunar landings.

Companies will develop human landing systems and NASA will purchase transport services, while maintaining oversight to ensure safety standards are met.



Human Landing System (HLS)

- Developed by U.S. industry, based on NASA requirements
- Carries crew to the lunar surface and returns them to lunar orbit
- Serves as a habitat on the lunar surface for early Artemis missions
- Houses equipment for surface activities including moonwalks, sample collection, and scientific experiments

Initial Human Landing System

HLS

NASA has awarded SpaceX a contract to develop its HLS Starship for use on Artemis III, the mission that will put the next two Americans on the surface of the Moon.

The contract includes two surface missions:

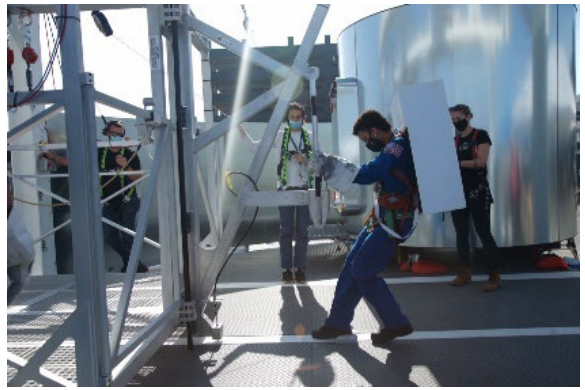
- SpaceX Uncrewed Lunar Demo-A
- SpaceX Crewed Lunar Demo-A

Image Credit: SpaceX

Initial HLS Starship Progress

Image Credit: SpaceX

Crew and cargo elevator



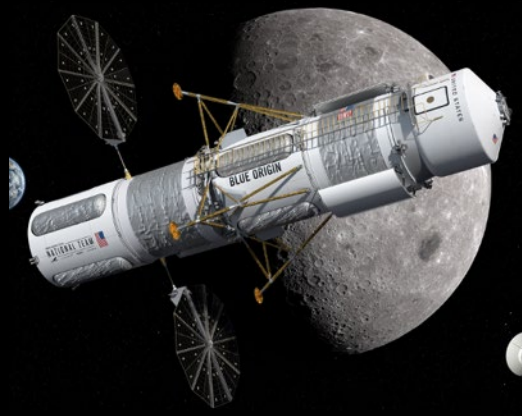
Crew cabin VR evaluation

Airlock

NextSTEP Appendix N: Sustainability Studies

In preparation for Sustaining Lunar Development, NASA selected five providers in September 2021 to develop lander design concepts, evaluate mission requirements, and mitigate risks by conducting critical component tests and advancing the maturity of key technologies.

BLUE ORIGIN



Dynetics
A Leidos Company

LOCKHEED MARTIN

NORTHROP GRUMMAN

SPACEX

HUMANS

in lunar orbit

In the unique lunar environment, new truths of our solar system can be unlocked. For the first time, humans will establish a long-term outpost in lunar orbit where they can live and work: Gateway.

GATEWAY

Initial capability

The two foundational elements of Gateway will launch together, establishing a platform where astronauts can live and work in lunar orbit

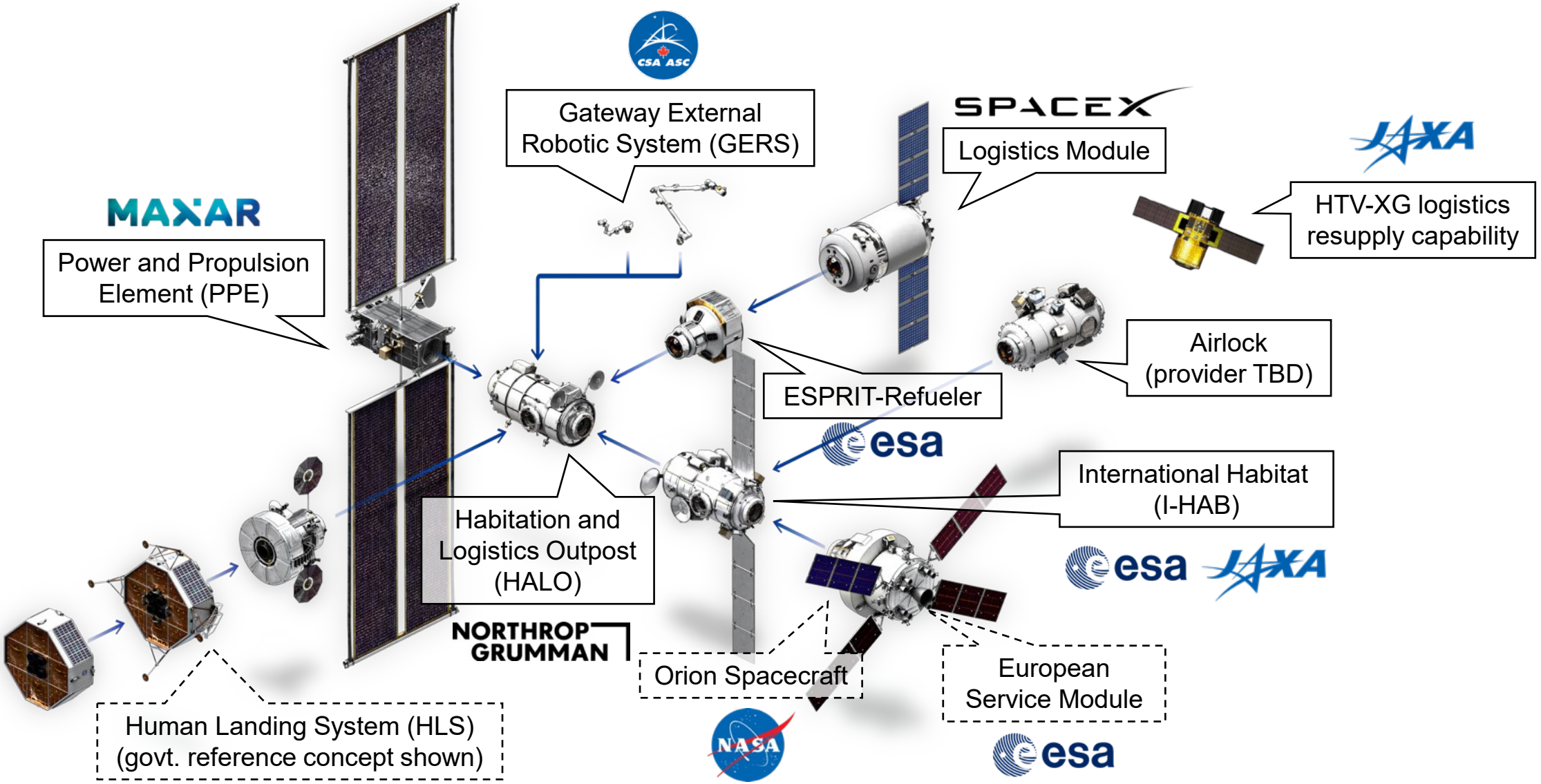
Power and Propulsion Element (PPE)

- High-power solar electric propulsion spacecraft
- Transfers the initial capability to lunar orbit
- Establishes a communications relay with Earth
- Maintains the Gateway's orbit

Habitation and Logistics Outpost (HALO)

- Houses up to 4 crew for up to 30 days (with Orion)
- Provides high-rate lunar communication relay to support lunar surface activities and command and control systems for Gateway
- Docking port for visiting spacecraft and future modules

Gateway Integrated Spacecraft



GATEWAY'S UNIQUE ORBIT

There are many ways to orbit the Moon, and each has its pros and cons. Gateway will travel in a near-rectilinear halo orbit to support missions to the lunar surface and serve as a staging point for exploration farther into the solar system, including Mars.

NEAR-RECTILINEAR HALO ORBIT (NRHO)

ACCESS
Easy to access from Earth orbit with many current launch vehicles; staging point for both lunar surface and deep space destinations

ENVIRONMENT
The deep space environment is useful for radiation testing and experiments in preparation for missions to the lunar surface and Mars

SCIENCE
Favorable vantage point for Earth, sun and deep space observations

COMMUNICATIONS
Provides continuous view of Earth and communication relay for lunar farside

SURFACE OPERATIONS
Supports surface telerobotics, including lunar farside; provides a staging point for planetary sample return missions

ORBIT TYPES

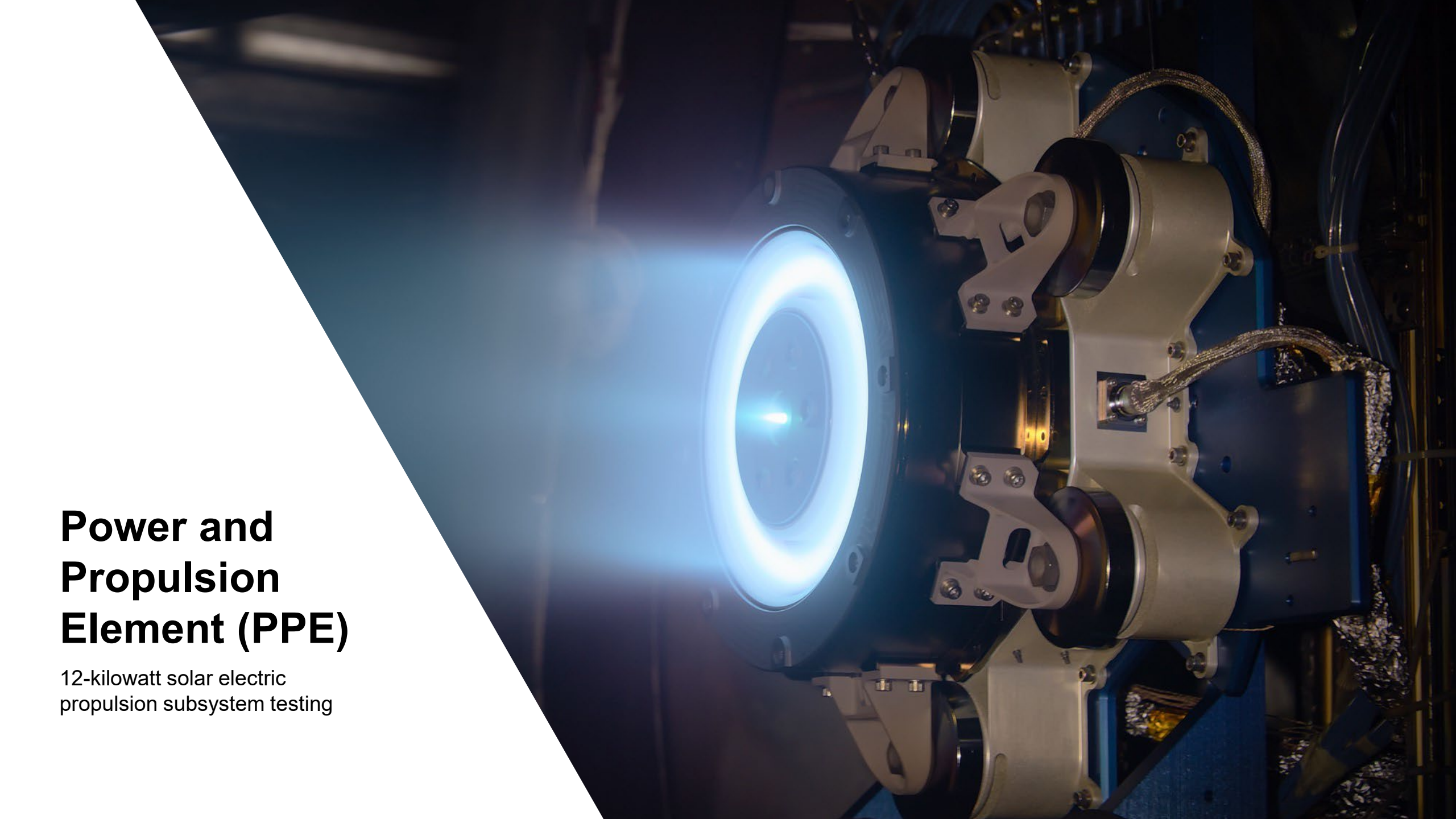
LOW LUNAR ORBITS
Circular or elliptical orbits close to the surface; excellent for remote sensing, difficult to maintain in gravity well.
» Orbit period: 2 hours

DISTANT RETROGRADE ORBITS
Very large, circular, stable orbits; easy to reach from Earth, but far from the lunar surface
» Orbit period: 2 weeks

HALO ORBITS
Fuel-efficient orbits revolving around Earth-Moon neutral-gravity points
» Orbit period: 1-2 weeks

Power and Propulsion Element (PPE)

12-kilowatt solar electric propulsion subsystem testing



Advanced SUITS

- Increased flexibility for exploring new regions and advanced sample collection
- Increased size range and modular design accommodate a wider range of crew members
- Rechargeable systems enable more spacewalks and longer stays on surface
- Specialized tools to collect quality samples and returned them safely to Earth
- NASA has selected Axiom Space and Collins Aerospace to build the next generation of spacesuit and spacewalk systems

Pictured left: Artist's render of an astronaut inspecting potential locations to collect samples on the lunar surface

Lunar Terrain Vehicle

L T V

An unpressurized rover will expand exploration area, enable groundbreaking discoveries, and provide autonomous or remote operations when crew are not on the surface.

Pictured left: Artist's render of LTV on the lunar surface


ARTEMIS
Base Camp
A truly sustainable infrastructure on the lunar surface

ARTEMIS BASE CAMP

A truly sustainable infrastructure on the lunar surface

- A pressurized rover expands exploration range
- A surface habitat enables longer duration stays
- Supported with small logistics landers including commercial lunar payloads services
- A wide range of opportunities for international partnerships
- Science investigations, technology demonstrations, and operational analogs for Mars missions

A Global Community

International partnerships are critical to the next era of human exploration and expansion

- Artemis Accords
- Gateway MOUs
- Scientific collaborations

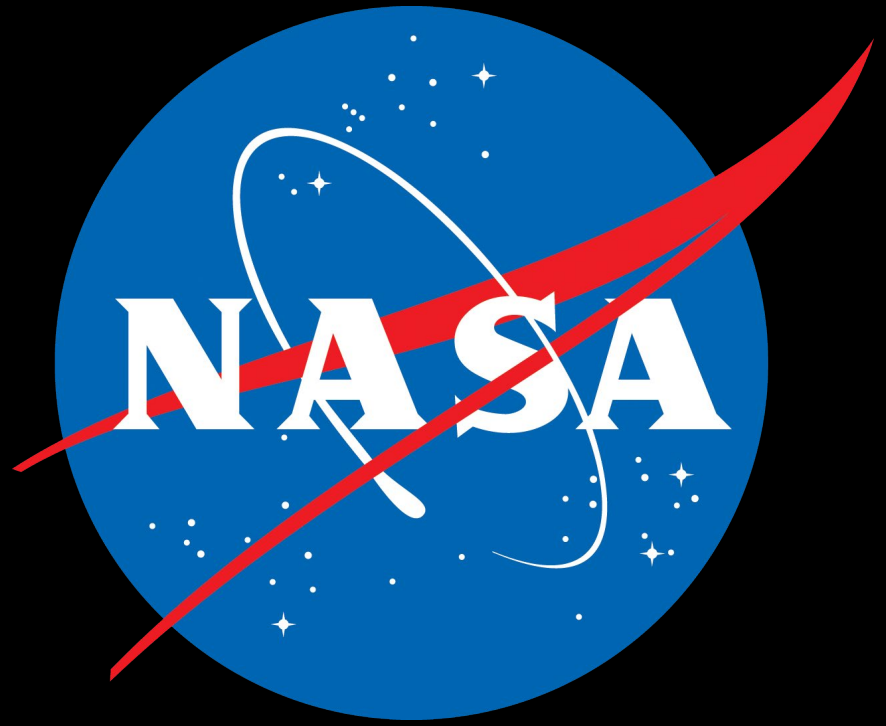
These are just some examples of how we're collaborating. NASA is actively seeking opportunities to partner with other nations as Artemis grows.

Pictured left: Republic of Korea Minister of Science and ICT Lim Hyesook signs the Artemis Accords.

We’re going to the Moon,
and we need your help!

QUESTIONS?

@NASAARTEMIS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