National Aeronautics and Space Administration

Human Exploration Strategy

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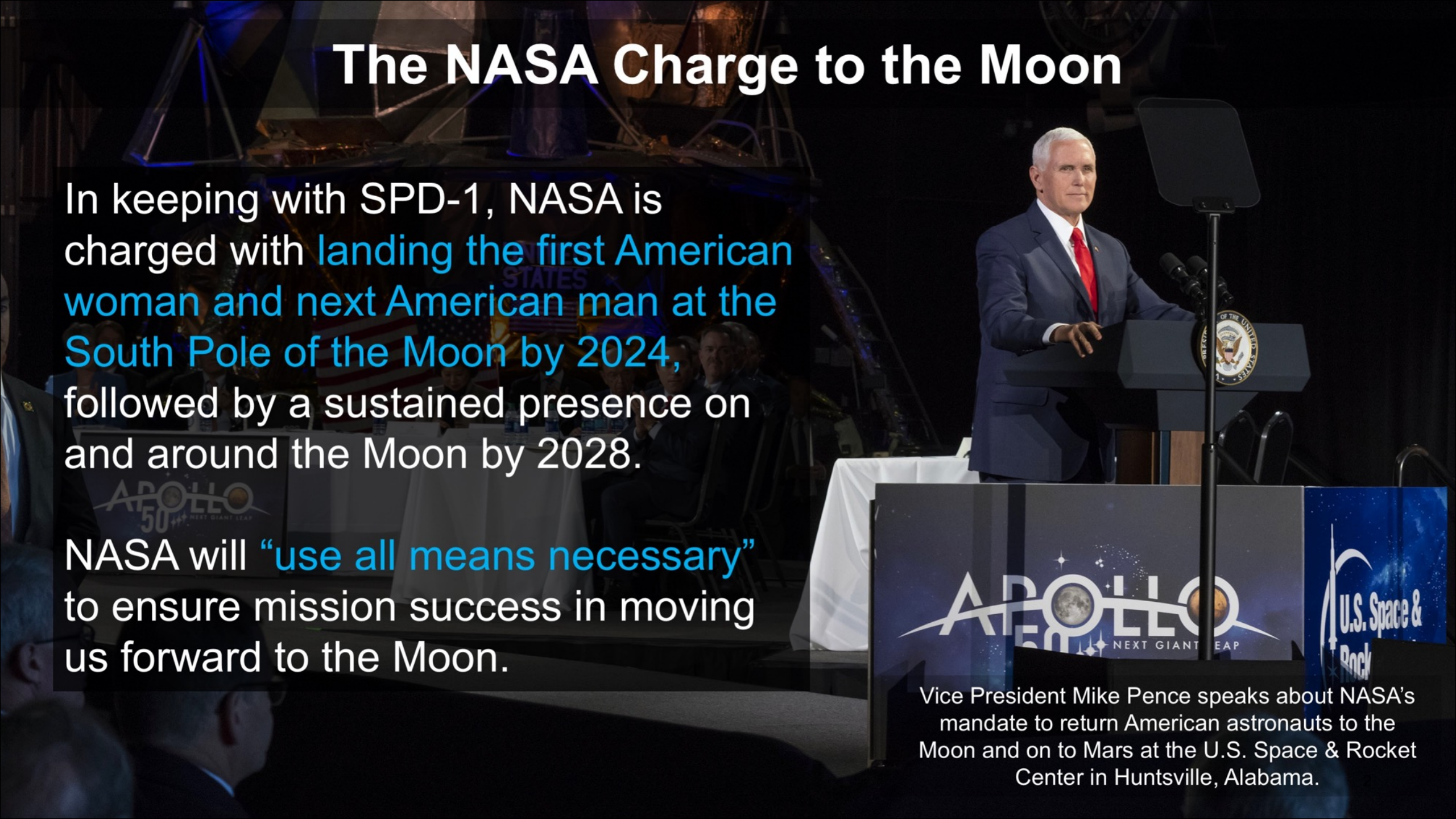
The NASA Charge to the Moon

In keeping with SPD-1, NASA is charged with landing the first American woman and next American man at the South Pole of the Moon by 2024, followed by a sustained presence on and around the Moon by 2028.

NASA will "use all means necessary" to ensure mission success in moving us forward to the Moon.



Vice President Mike Pence speaks about NASA's mandate to return American astronauts to the Moon and on to Mars at the U.S. Space & Rocket Center in Huntsville, Alabama.

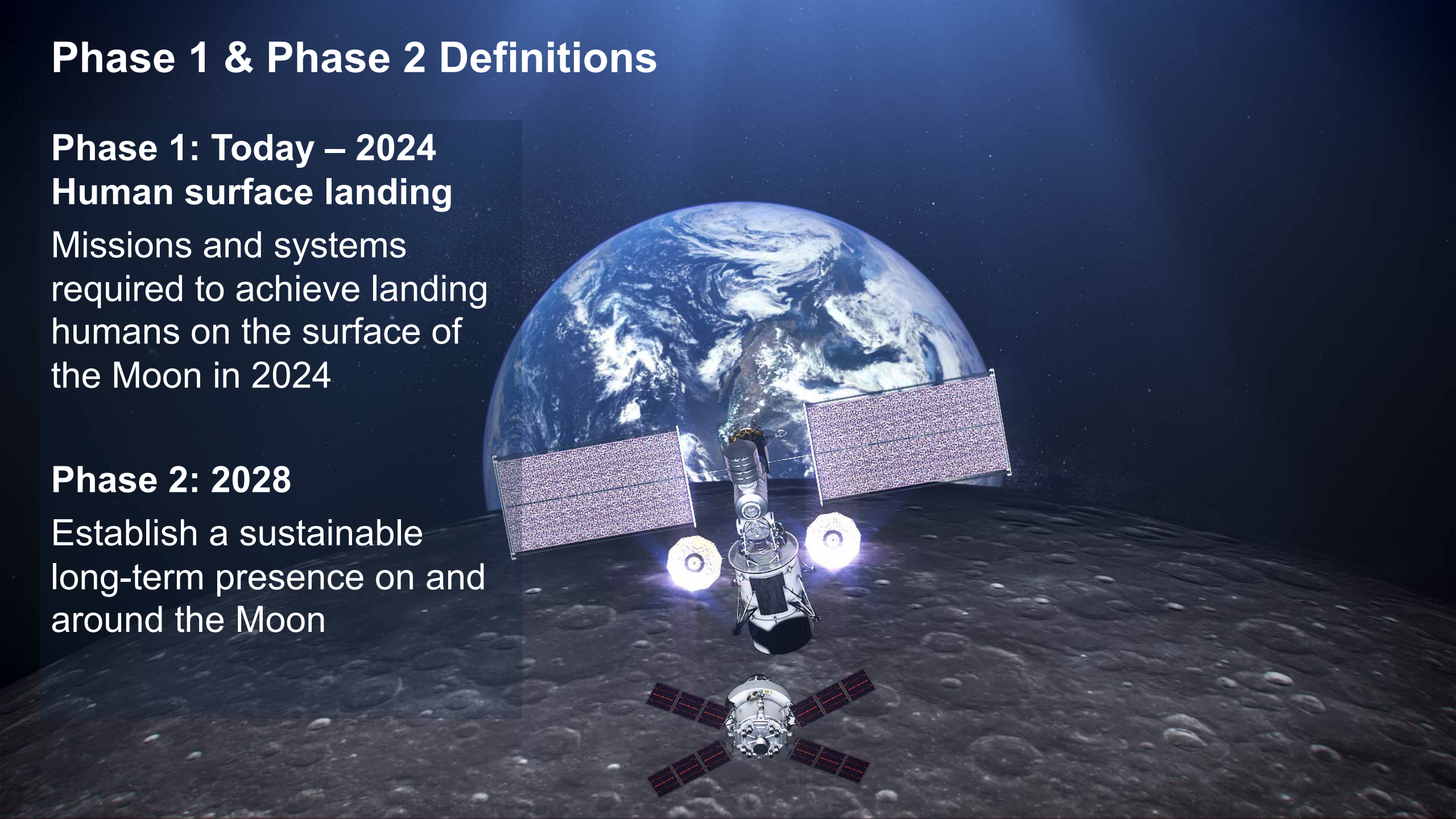
Phase 1 & Phase 2 Definitions

Phase 1: Today – 2024
Human surface landing

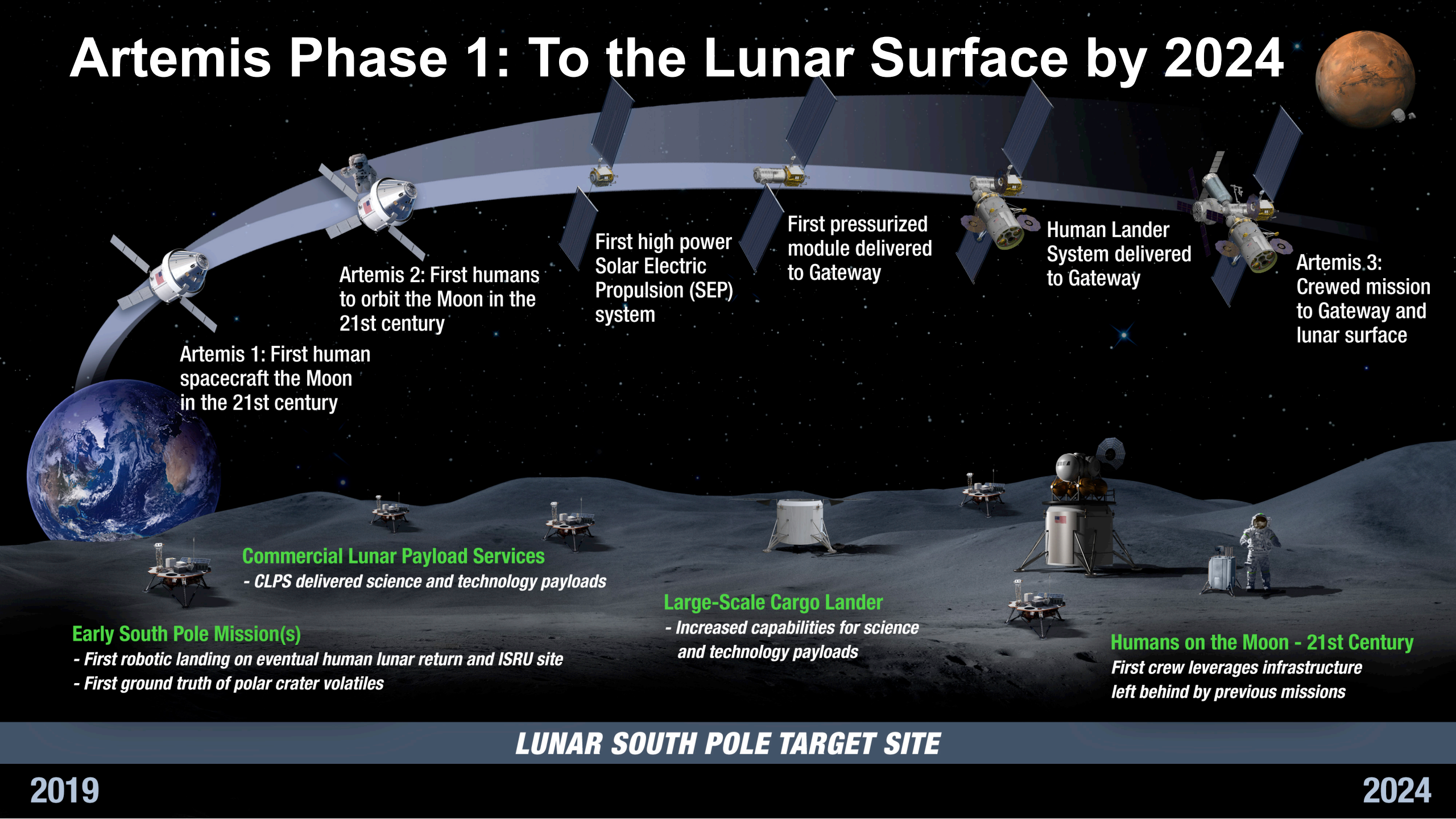
Missions and systems required to achieve landing humans on the surface of the Moon in 2024

Phase 2: 2028

Establish a sustainable long-term presence on and around the Moon

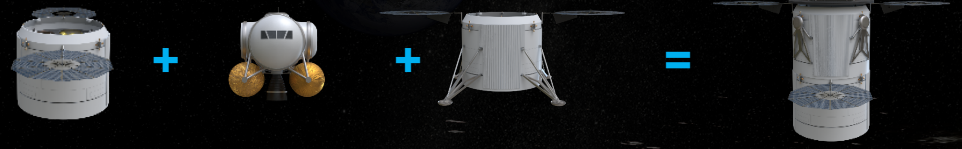


Artemis Phase 1: To the Lunar Surface by 2024



Current Thoughts on Human Landing System

HLS Notional Transportation Elements



Transfer + Ascent + Descent = Aggregate at Gateway

DEVELOPMENT IS UNDERWAY

2024

Develop essential hardware and systems required for a 2024 landing

CREW

At least 2 on the South Pole

SUITS

Initial capability suit

EXPEDITION DURATION

Hours-Days
(open trade)

ROCKETS
(examples)

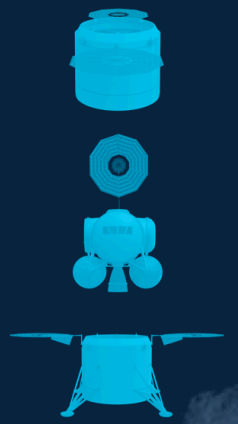
PARTNERS

Significant collaboration with U.S. industry

Potential opportunities for international partners

ACCESS

REUSABILITY
Desired, but not required



2028

Establish a sustainable human lunar presence with robust, reusable systems

CREW

Up to 4 on the Moon

SUITS

Sustained capability suit

EXPEDITION DURATION

Days-Weeks
(open trade)

ROCKETS
(examples)

PARTNERS

U.S. industry and international collaboration

ACCESS

Increased mobility from the pole; global access through robotic landings and possible human sorties

REUSABILITY
Enables sustainability

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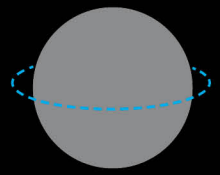
Gateway is Essential for 2024 Landing

- Initial Gateway focuses on the minimum systems required to support a 2024 human lunar landing while also supporting Phase 2
- Provides command center and aggregation point for 2024 human landing
- Establishes strategic presence around the Moon – US in the leadership role
- Creates resilience and robustness in the lunar architecture
- Open architecture and interoperability standards provides building blocks for partnerships and future expansion

GATEWAY ORBIT

Cislunar space offers innumerable orbits for consideration, each with merit for a variety of operations. The Gateway will support missions to the lunar surface and serve as a staging area for exploration farther into the solar system, including Mars.

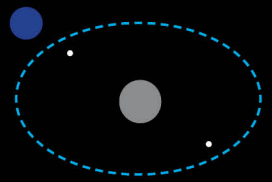
ORBIT TYPES



LOW LUNAR ORBITS

Circular or elliptical orbits close to the surface. Excellent for remote sensing, difficult to maintain in gravity well.

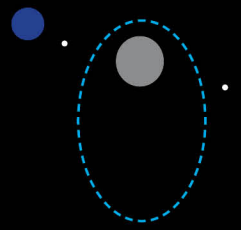
» Orbit period: 2 hours



DISTANT RETRO-GRADE ORBITS

Very large, circular, stable orbits. Easy to reach from Earth, but far from lunar surface.

» Orbit period: 2 weeks



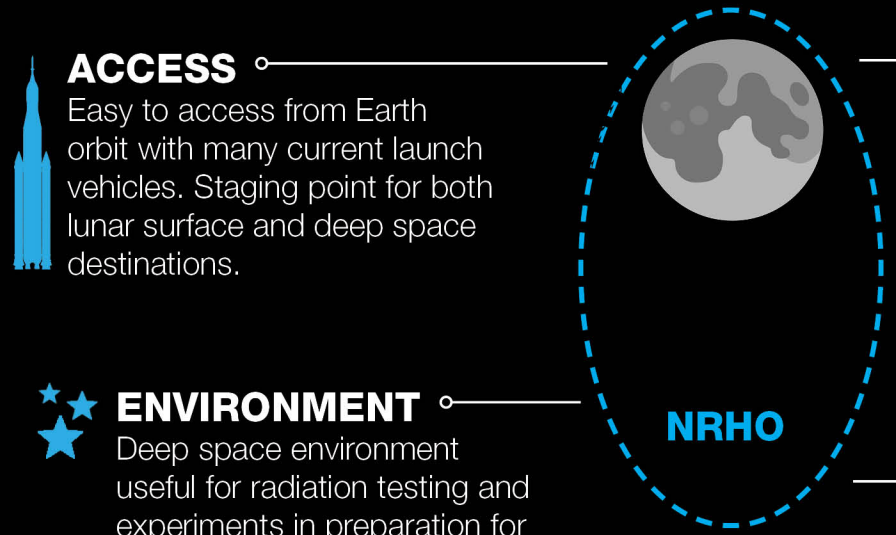
HALO ORBITS

Fuel-efficient orbits revolving around Earth-Moon neutral-gravity points.

» Orbit period: 1-2 weeks

NEAR-RECTILINEAR HALO ORBIT (NRHO)

1,500 km at its closest to the lunar surface, 70,000 km at its farthest.



ACCESS

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

ENVIRONMENT

Deep space environment 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.

Lunar Science by 2024

Polar Landers and Rovers

- First direct measurement of polar volatiles, improving our understanding of their lateral and vertical distribution, as well as their physical state and chemical composition
- Information on the geology of the South-Pole Aitken basin, the largest impact in the solar system

Non-Polar Landers and Rovers

- Ability to explore scientifically valuable terrains not explored by Apollo.
  Examples include:
  - Land at a lunar swirl and make the first surface magnetic measurement
  - Visit young volcanic features such as Ina to understand volcanic evolution
- PI-led instruments - Discovery-class science such as geophysical network and visiting lunar volcanic region

Artemis 1 – Cube Satellite Program

- Over a dozen satellites will be launched as part of Artemis 1

Orbital Data

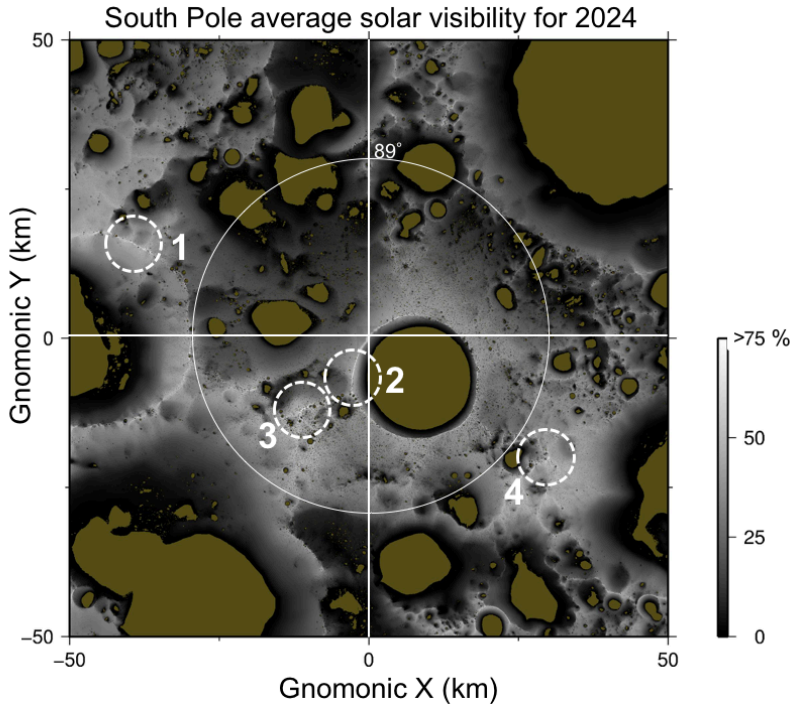
- Cubesats delivered by CLPS providers, or comm/relay spacecraft could acquire new scientifically valuable datasets
- Global mineral mapping (including resource identification), global elemental maps, improved volatile mapping

In-Situ Resource Initial Research

- What is the composition and ability to use lunar ice for sustainment and fuel

American Strategic Presence on the Moon –

High solar illumination areas within 2 degrees (<50 km) of the lunar south pole.



Four highly illuminated areas shown above:

1. De Gerlache Rim,
2. Shackleton Rim
3. Shackleton – De Gerlache Ridge
4. Plateau near Shackleton

High Priorities for Sustained Surface Activities

- **Long duration access to sunlight:** A confirmed resource providing power and minimal temperature variations
- **Direct to Earth communication:** Repeatable Earth line-of-sight communication for mission support
- **Surface roughness and slope:** Finding the safest locations for multiple landing systems, robotic and astronaut mobility
- **Permanently Shadowed Regions and Volatiles:** Learning to find and access water ice and other resources for sustainability

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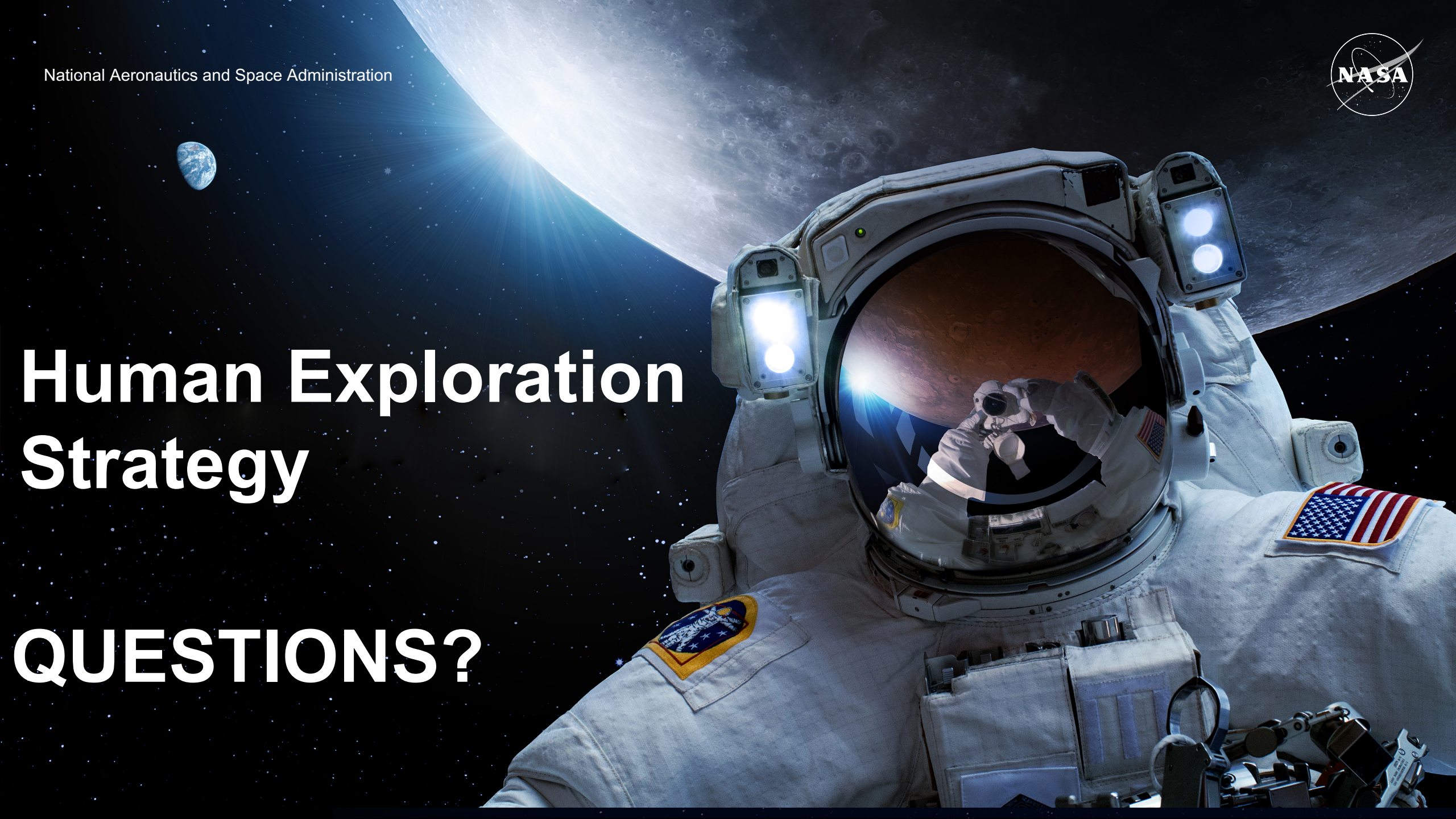

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QUESTIONS?