

March 30, 2023  
ASCENDxTexas  
*NASA Program Update Panel*



# ARTEMIS

**Catherine Koerner**

**Deputy Associate Administrator**

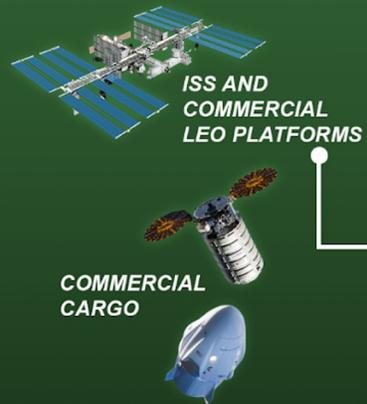
**Exploration Systems Development  
Mission Directorate**

**NASA Headquarters, Washington D.C.**

# MOON TO MARS CAMPAIGN SEGMENTS

ELEMENTS SHOWN BEYOND HUMAN LUNAR RETURN ARE NOTIONAL

## LEO AND EARTH ANALOGS



## HUMAN LUNAR RETURN



Increased Crew Size & Longer Durations in Micro-gravity

## FOUNDATIONAL EXPLORATION

### HUMANS TO MARS MODEST FIRST MISSION OF THE TRADE SPACE SHOWN



TRANSIT HABITAT AND MARS TRANSIT

COMMUNICATIONS RELAYS

SURFACE HABITAT

LOGISTICS LANDER

Nuclear Surface Power

MARS ASCENT VEHICLE

Habitation Systems

Partial Gravity Operations

Mobile Expedition Duration / Mobile Exploration Range

PRESSURIZED ROVER

In-Situ Resource Utilization

Autonomous Robotics Systems & Contingency Crew Transportation

MARS TERRAIN VEHICLE

Sustained Lunar Evolution



# Evolutionary Architecture Process



The purpose of an Architecture Concept Review (ACR) is to help unify the agency, promote advocacy for the architecture, and generate inputs from across NASA.



## Goal of Architecture Concept Review 22

*ACR22 reached concurrence on...*

- Newly established ACR process
- Disposition of key issues from review of Moon to Mars Architecture Definition Document
- Priority tasks for ACR23

## Future Architecture Concept Reviews

*Further refinements will align with budget cycle to accommodate for evolving...*

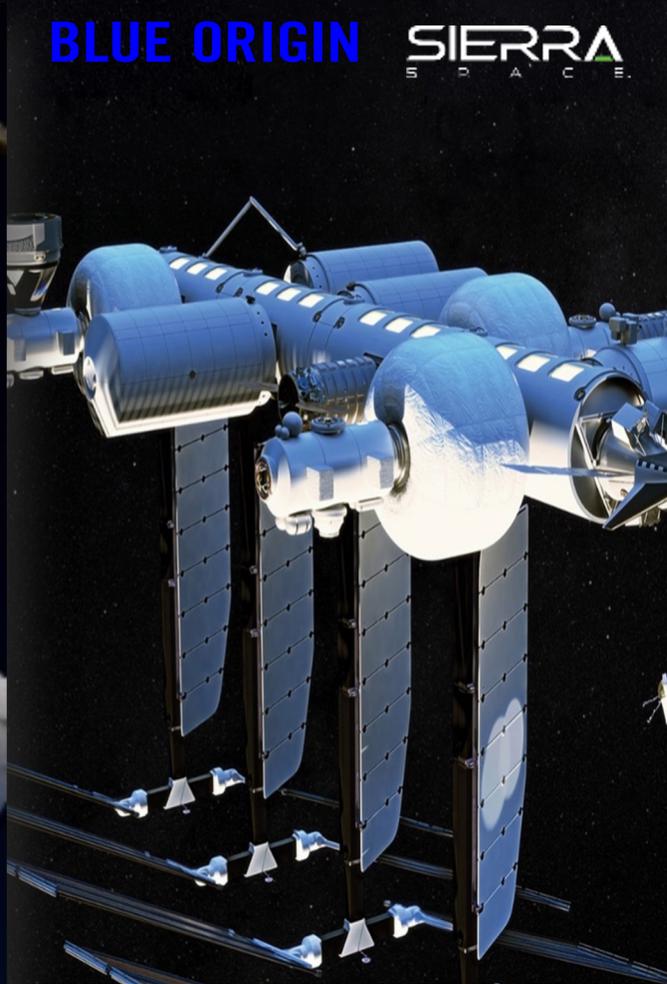
- Policy
- Budget
- Partner Contributions
- Technology Development Schedules



COMMERCIAL LEO  
DEVELOPMENT  
PROGRAM

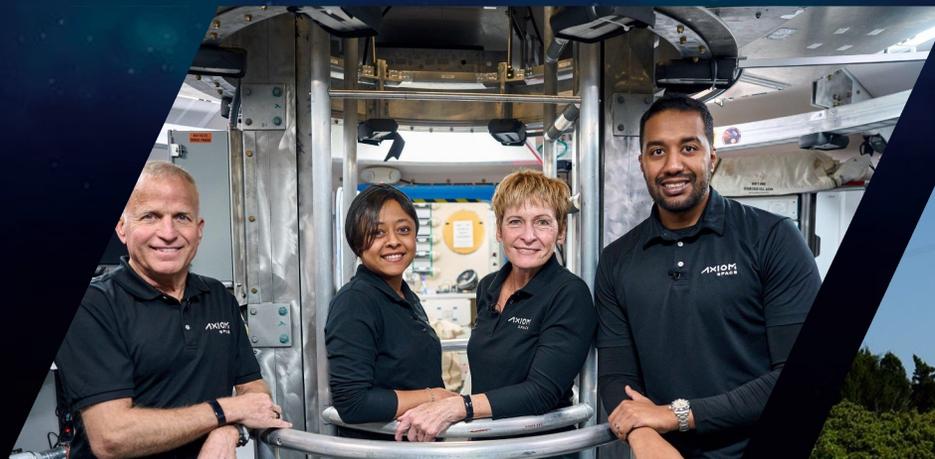
Angela Hart  
Program Manager  
March 2023

# Commercial LEO Destination



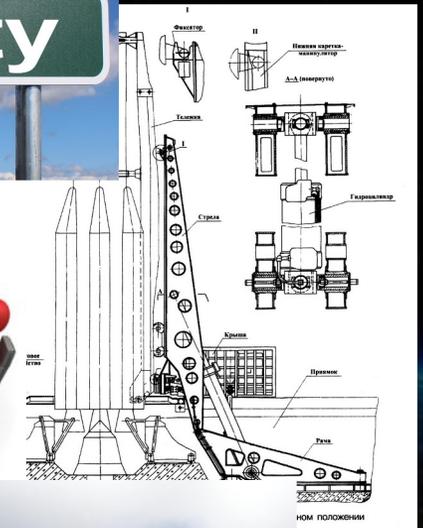


# Private Astronaut Missions



# Architecture Development and Industry Collaboration

- RFI #1 released:
  - Draft Human Certification Requirements (Level 1)
  - Overall CLD destination philosophy
- RFI #2 released:
  - CLD ConOps whitepaper
  - Utilization Capabilities and Resources whitepaper
- Other RFIs/Studies in work:
  - Draft Level 2 End to End Requirements (Summer 2023)
  - Certification and Safety Strategy (Fall 2023)
  - Updated Utilization Capabilities and Resources post Decadal
  - Liability Framework
  - Future LEO National Lab Framework





# Question and Answer



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# ARTEMIS

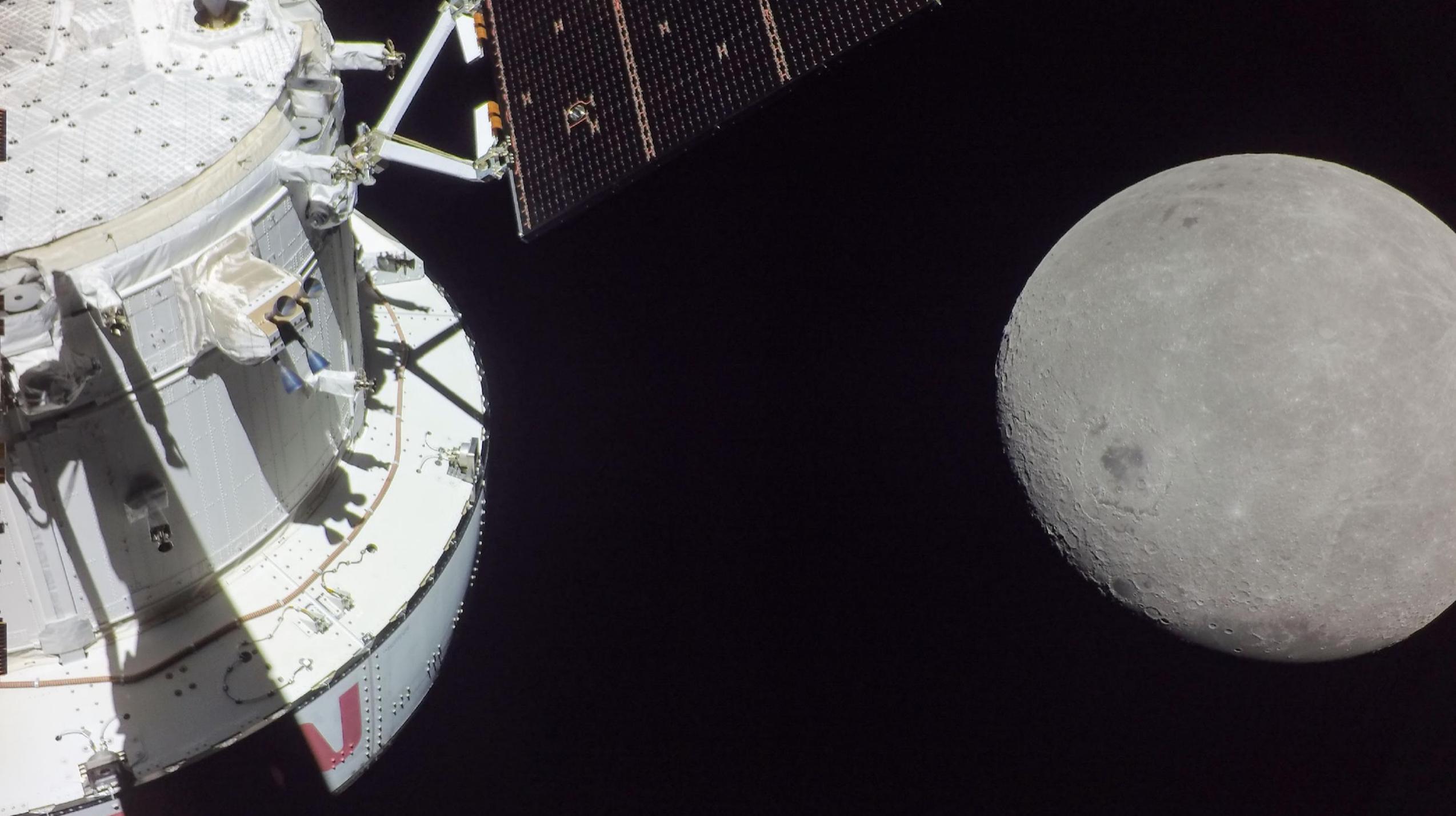
**Amit Kshatriya**

**Deputy Associate Administrator (Acting),  
Common Exploration Systems  
Development Division**

**Exploration Systems Development  
Mission Directorate**

**NASA Headquarters, Washington D.C.**





# Artemis I



## MISSION COMPLETE:

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

## 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

## NEW ELEMENTS:

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

## Artemis I: 2022

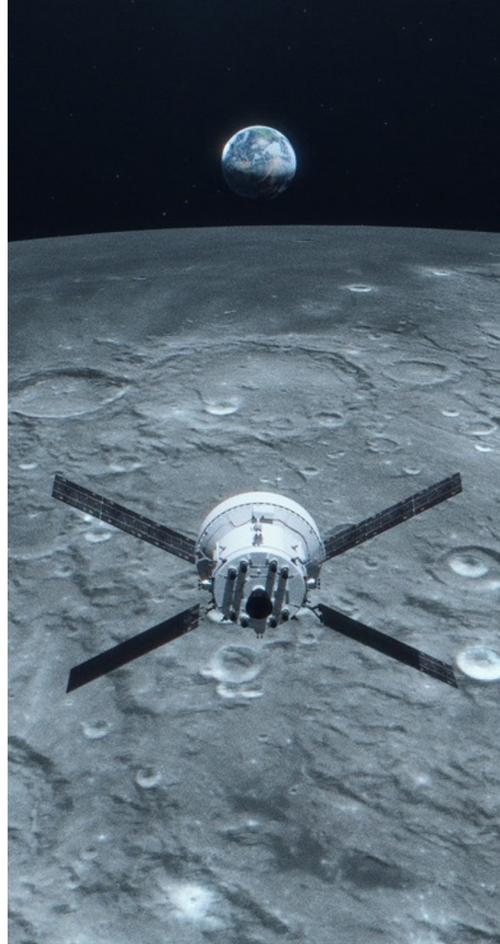
Uncrewed flight test  
**COMPLETE**



SLS, Orion, EGS

## Artemis II: 2024

Crewed flight test



SLS, Orion, EGS

## Artemis III: 2025

Crewed surface  
expedition



SLS, Orion, EGS, HLS,  
Spacesuits

## Artemis IV

Gateway assembly,  
crewed sustaining  
lander expedition



SLS, Orion, EGS,  
HLS, Spacesuits, Gateway  
(PPE/HALO, I-HAB)

## Artemis V

Crewed mobile  
surface exploration,  
Gateway expansion



SLS, Orion, EGS,  
HLS, Spacesuits, LTV,  
Gateway (ESPRIT,  
Canadarm3)



# Question and Answer

# GATEWAY



HUMANITY'S FIRST SPACE STATION IN LUNAR ORBIT

Emma Lehnhardt

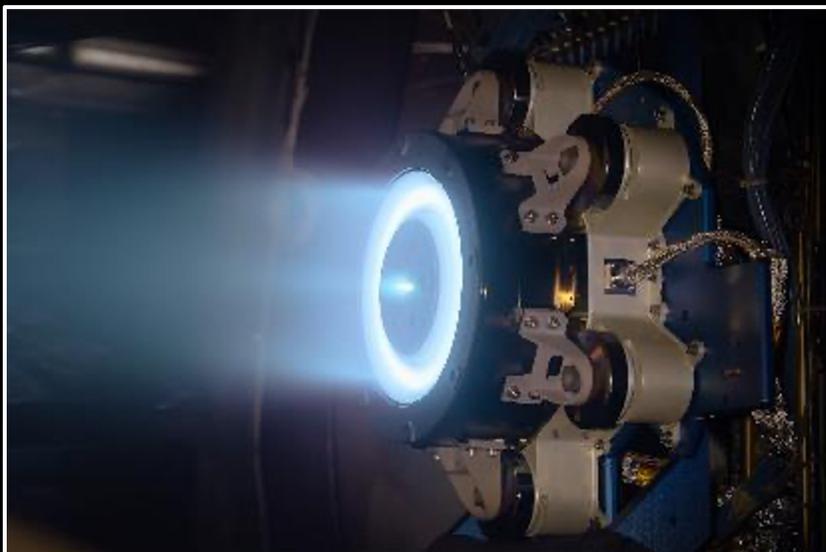
Gateway Program Planning & Control Manager

*Last updated: Jan. 2023*

# Gateway is going

*Major initial elements progressing from concept to reality ahead of a 2025 launch to lunar orbit.*

PPE thruster testing at NASA's Glenn Research Center in Cleveland, Ohio and central cylinder development in Palo Alto, California

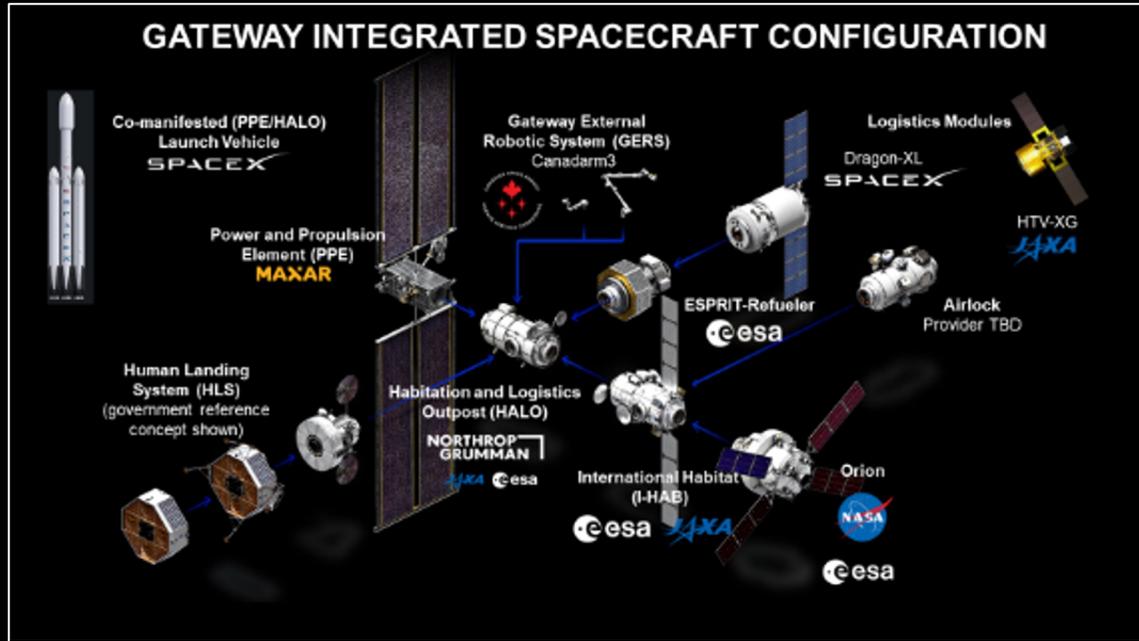


HALO fabrication in Turin, Italy



# Challenges and opportunities

## Integration and operational flexibility



## Fiscal uncertainty



# GATEWAY INTEGRATED SPACECRAFT CONFIGURATION



Co-manifested (PPE/HALO)  
Launch Vehicle  
**SPACEX**

Power and Propulsion  
Element (PPE)  
**MAXAR**

Gateway External  
Robotic System (GERS)  
Canadarm3



Logistics Modules

Dragon-XL  
**SPACEX**



HTV-XG  
**JAXA**

ESPRIT-Refueler  
**esa**

Airlock  
Provider TBD

Human Landing  
System (HLS)  
(government reference  
concept shown)



Habitation and Logistics  
Outpost (HALO)

**NORTHROP  
GRUMMAN**  
**JAXA** **esa**

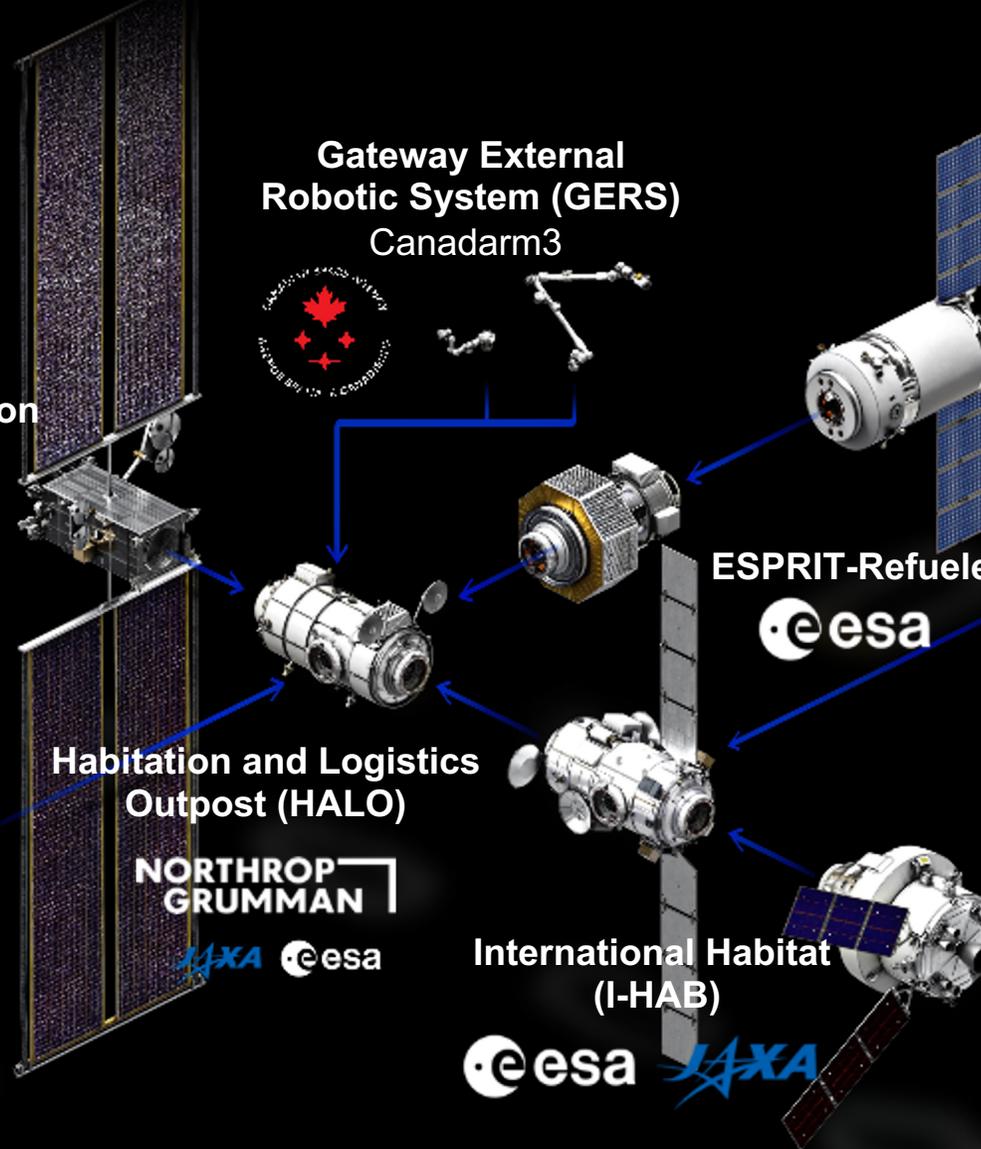
International Habitat  
(I-HAB)

**esa** **JAXA**

Orion



**esa**





# Question and Answer

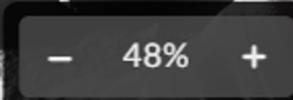




# EVA and Human Surface Mobility Program (EHP) Overview

Chris Hansen

March 2023





# EHP Lunar Elements

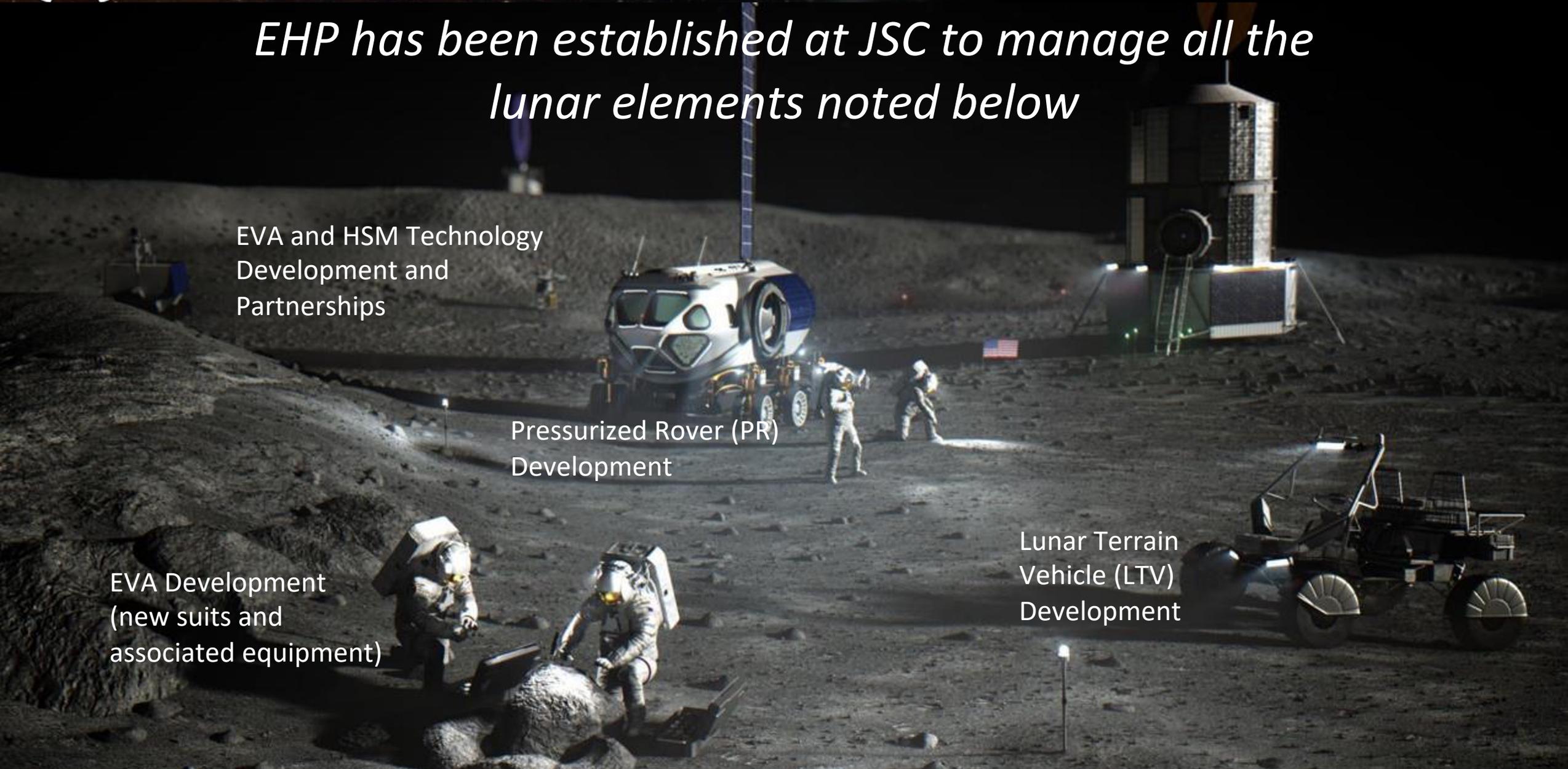
*EHP has been established at JSC to manage all the lunar elements noted below*

EVA and HSM Technology  
Development and  
Partnerships

Pressurized Rover (PR)  
Development

Lunar Terrain  
Vehicle (LTV)  
Development

EVA Development  
(new suits and  
associated equipment)





# Advanced



# S U I T S

- 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 Artemis astronaut inspecting and collecting samples on the lunar surface

# ISS EVA Support

EHP is also responsible for the continued safe and successful execution of all ISS EVAs



*Multiple EVAs are planned for 2023 to continue ISS upgrades*

# LTV

## Lunar Terrain Vehicle Unpressurized Rover

### *Vison for LTV*

- Initial surface transportation system for Artemis V and beyond
- Significantly extends the range of crew excursions
- Enables more science, resource prospecting, and exploration on the lunar surface
- Tele-operation to perform remote science during the non-crewed periods
- Transport and deploy small payloads
- Provide a manipulator to support science activities
- Provide video and imagery of landings, points of interest, and crew activities
- Inform and guide the design and execution of future lunar and Mars surface mobility solutions

*LTV contract is in work and should be awarded by the end of FY23*

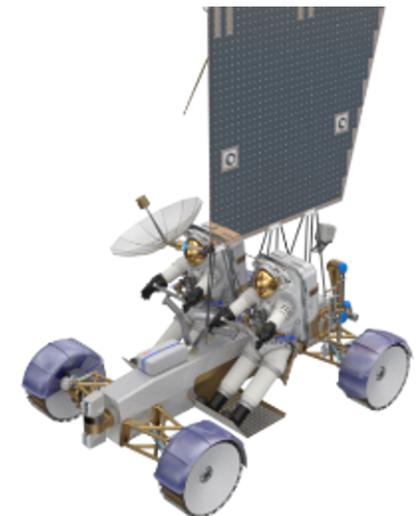
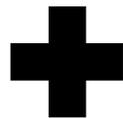
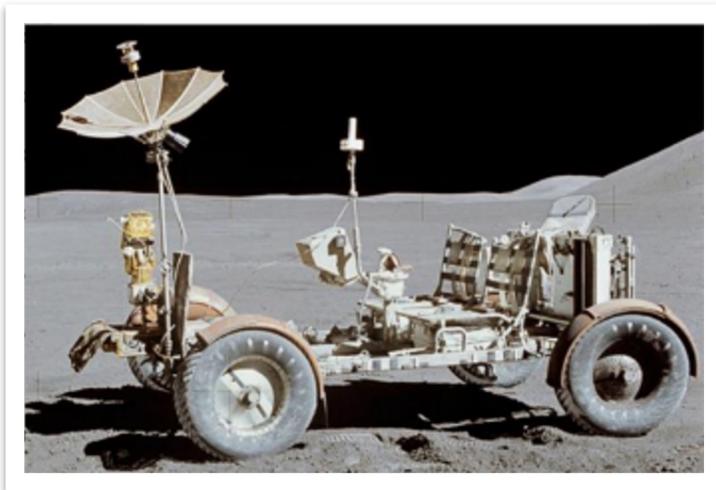
- *Draft RFP was released on Nov 1<sup>st</sup> 2022*
- *Final RFP planned for May 2023 release*



# LUNAR TERRAIN VEHICLE



- Hybrid of both a **manned** Apollo style LRV and an **uncrewed science exploration** rover
- Initial surface transportation system for **Artemis V** and beyond
- Significantly extend the range of crew excursions
- Capable of **tele-operation**
- Transport and **deploy** small **payloads**
- **Support science** activities



Notional Concept  
For Illustration Purposes Only

# PRESSURIZED ROVER



PR is in the early stages of development and forming partnerships.

The use cases and utilization scenarios are ever increasing – formulating concepts and evaluating potential science and exploration rover missions around the Lunar South Pole

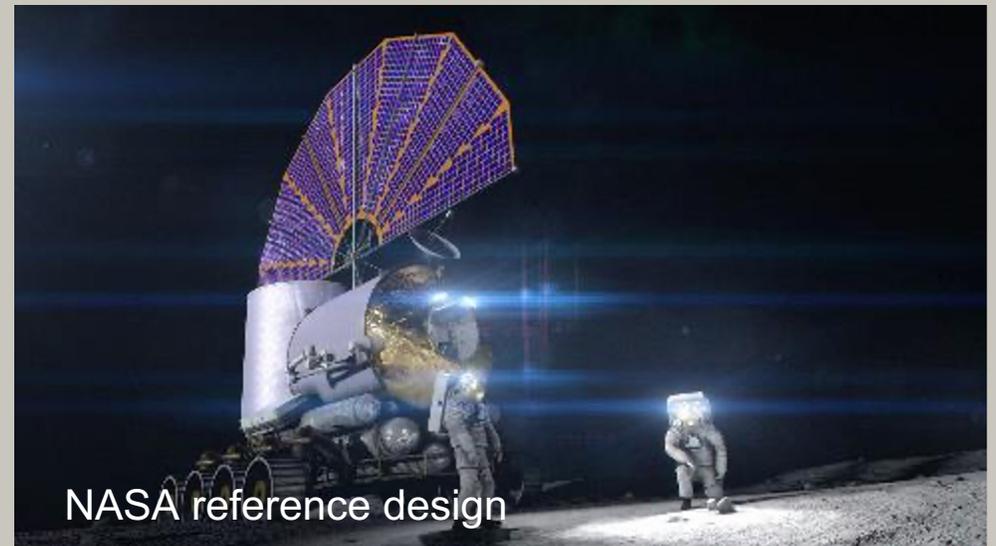
# PRESSURIZED ROVER



- **Pressurized Rover International Partner** agreement with **JAXA** is in work
- Planning for **Artemis VII**
- **2 crew for 14-30 days**, depending upon logistics
- Traveling **600-1000 km**



Feasibility reference design



NASA reference design

# Challenges for EHP



- Political/Managerial
  - Its been 50+ years
  - Integration across agencies, programs, and private sector
  - New services contract approach
- Technical
  - South pole environment
  - Communications and Surface Infrastructure
  - Integration across agencies, programs, and private sector companies



Thanks!





# Question and Answer





# Commercial Lunar Payload Services (CLPS) Landers





# Question and Answer

[nasa.gov/ARTEMIS](https://nasa.gov/ARTEMIS)



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