National Aeronautics and Space Administration


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HUMAN EXPLORATION AND OPERATIONS

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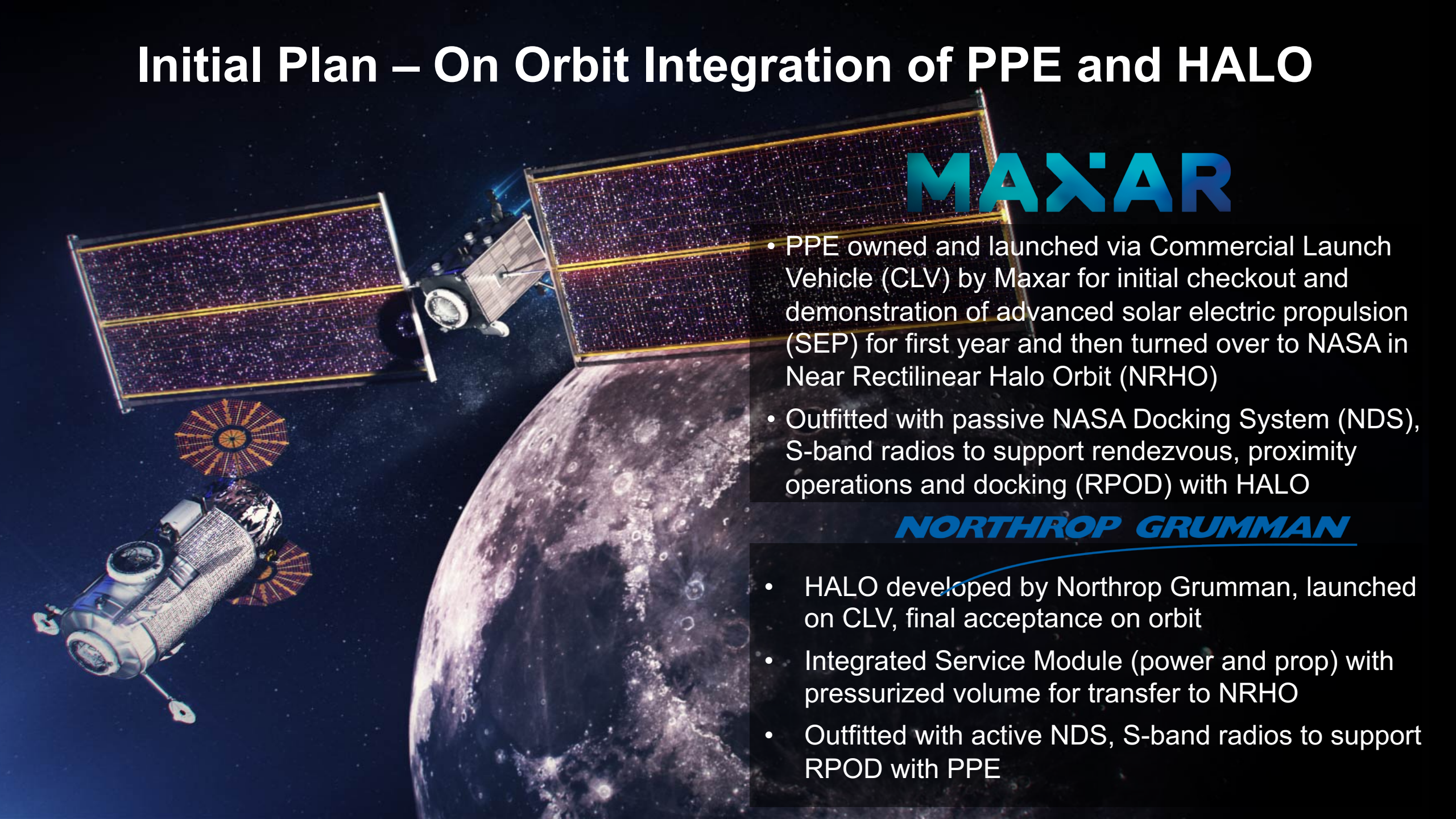
# Initial Plan – On Orbit Integration of PPE and HALO



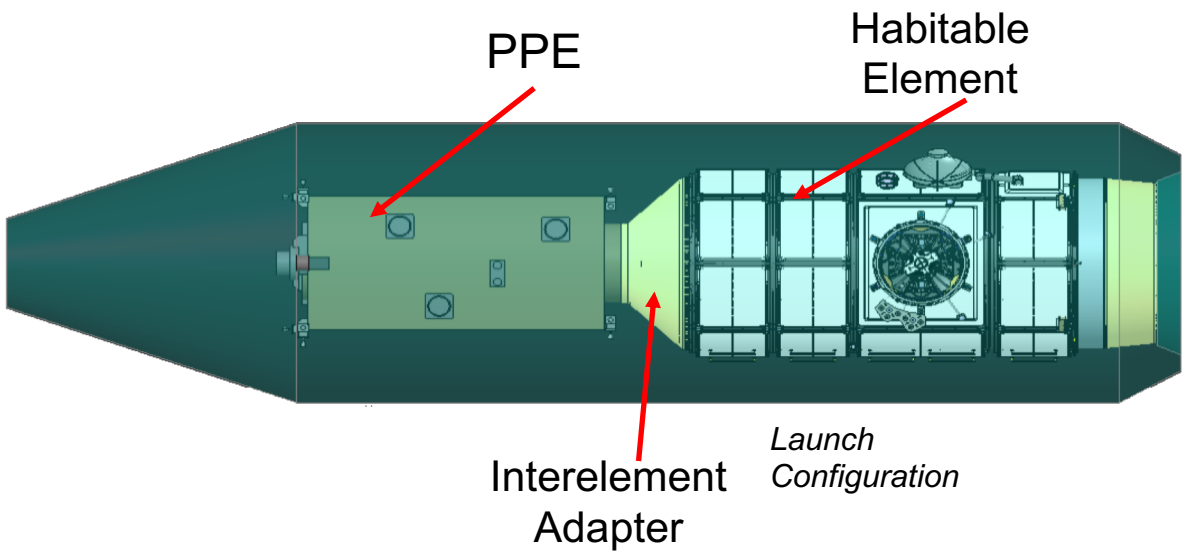
MAXAR

- PPE owned and launched via Commercial Launch Vehicle (CLV) by Maxar for initial checkout and demonstration of advanced solar electric propulsion (SEP) for first year and then turned over to NASA in Near Rectilinear Halo Orbit (NRHO)
- Outfitted with passive NASA Docking System (NDS), S-band radios to support rendezvous, proximity operations and docking (RPOD) with HALO

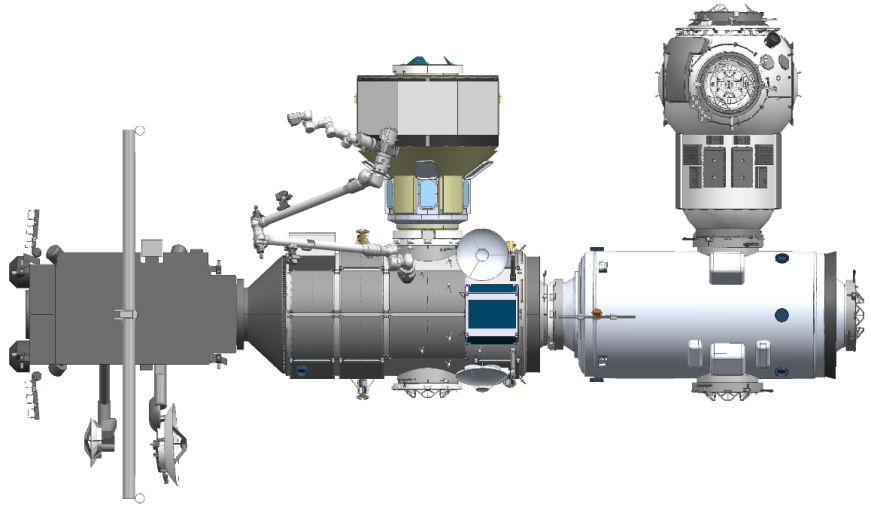
NORTHROP GRUMMAN

- HALO developed by Northrop Grumman, launched on CLV, final acceptance on orbit
- Integrated Service Module (power and prop) with pressurized volume for transfer to NRHO
- Outfitted with active NDS, S-band radios to support RPOD with PPE

# Co-manifest – Ground Integrated, Single Launch



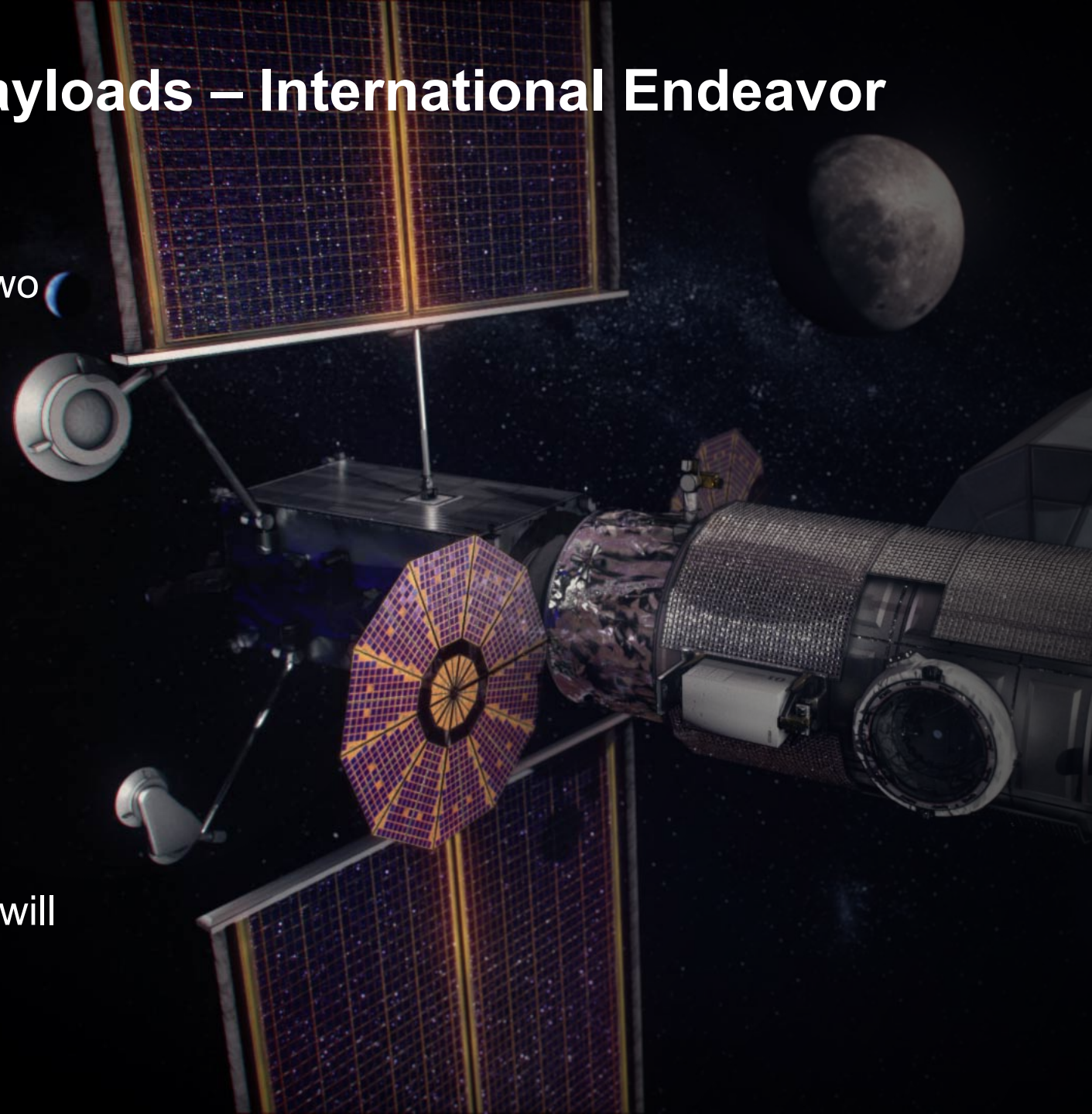

*Launch Configuration*



- Elements delivered to Kennedy Space Center for integration, testing, and turn over for launch
  - A draft Request for Launch Services Proposals was released on May 6 for the PPE/HALO launch.
  - The selection of the PPE/HALO launch provider will be made by the Launch Services Program (LSP) and anticipated to occur by late fall 2020.
- Eliminates one launch vehicle, service module, and on orbit assembly via RPOD
- Allocations of system distribution and components part of analysis cycle underway
- Launch targeted for November ’23, spiral out to NRHO via PPE SEP and chem ~ 270 days
- Enhances mission success by reducing on-orbit integration complexities

# Early Gateway Science Payloads – International Endeavor

- On March 12, NASA announced the first two science payloads to fly on Gateway
- One sponsored by NASA's Science Mission Directorate and the other by ESA (European Space Agency) payload
  - ESA's radiation instrument package will help provide an understanding of how to keep astronauts safe by monitoring the radiation exposure in Gateway's unique orbit
  - NASA's space weather instrument suite will observe solar particles and solar wind created by the Sun
- Gateway will be operational and research will continue when uncrewed



# Gateway Logistics Services (GLS)

SPACEX

- SpaceX selected as the first U.S. commercial provider under the Gateway Logistics Services contract to deliver cargo, experiments and other supplies to the agency's Gateway in lunar orbit

- Multiple supply missions planned in which the cargo spacecraft will stay at the Gateway for six to 12 months at a time
  - 5 MT delivered cargo capability
  - Power to internal and external payloads
  - Trash removal
  - Automated RPOD (docking/undocking)

- Firm-fixed price, indefinite delivery/indefinite quantity contract
  - Guaranteed two missions per logistics services provider with a maximum total value of $7 billion across all contracts as additional missions are needed

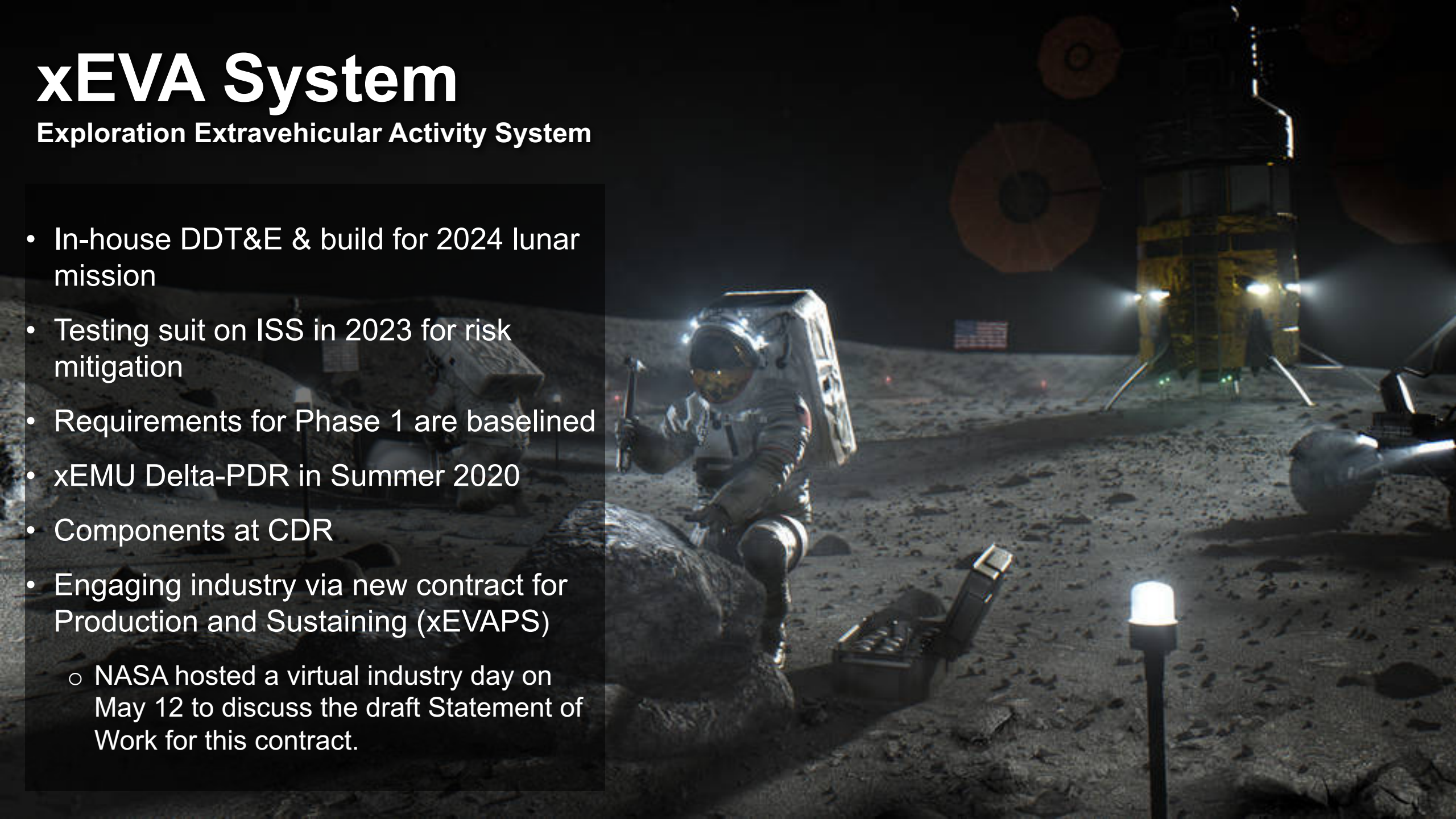
# Gateway International Partners

- Building on the ISS partnership, CSA, ESA, JAXA and Roscosmos have been coordinating with NASA to expand human exploration, leveraging the capabilities of the partnership.
- MOUs have been released and negotiations underway based on these contributions.
- International partners are embedded members within the Gateway team, with membership on Gateway Boards and technical integration embedded at all levels.

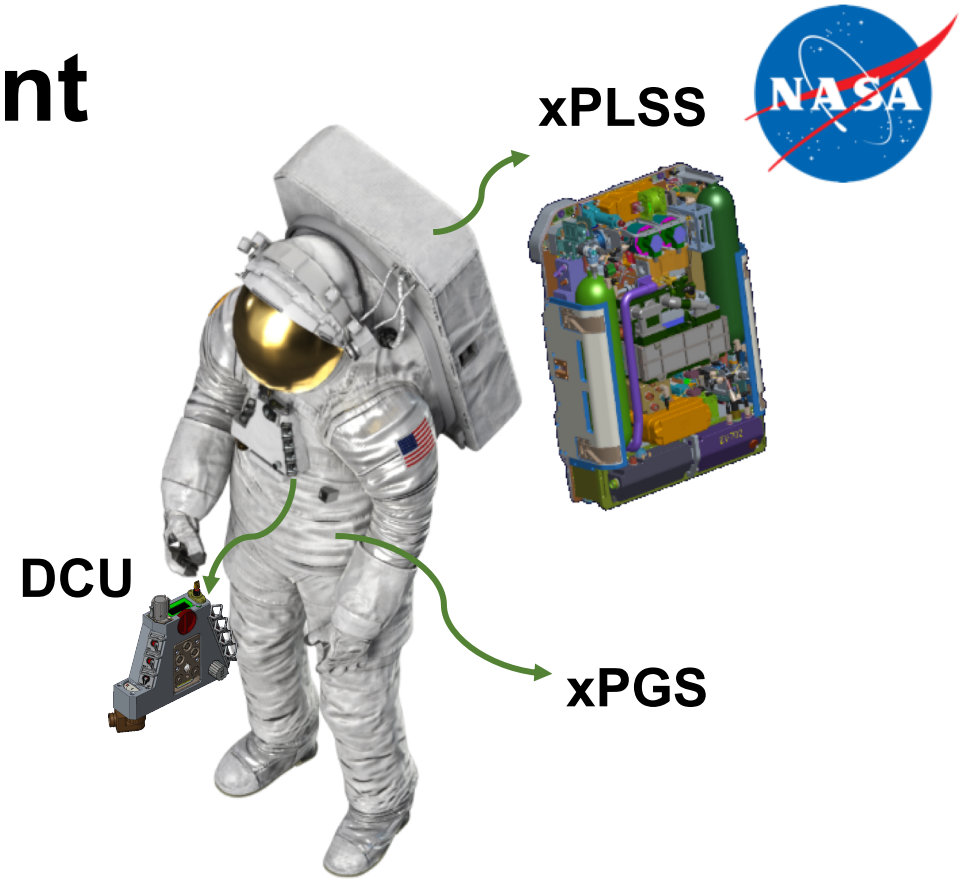
# xEVA System

**Exploration Extravehicular Activity System**

- In-house DDT&E & build for 2024 lunar mission
- Testing suit on ISS in 2023 for risk mitigation
- Requirements for Phase 1 are baselined
- xEMU Delta-PDR in Summer 2020
- Components at CDR
- Engaging industry via new contract for Production and Sustaining (xEVAPS)
    - NASA hosted a virtual industry day on May 12 to discuss the draft Statement of Work for this contract.



# xEMU Development




## The Exploration Portable Life Support Subsystem (xPLSS)

- Oxygen Assemblies
- Ventilation Loop, Thermal Control Loops
- Critical Radio Communications and Antennas
- Display and Control Unit (DCU), Caution and Warning System (CWS)
- Batteries

## The Exploration Pressure Garment Subsystem (xPGS)

- Upper Torso Assembly
  - Hard Upper Torso (HUT), shoulders, lower arms, helmet/visor
  - Hatch for rear entry don/doff
  - Gloves (EMU Phase VI)
- Lower Torso Assembly (LTA)

## Vehicle Interface and Flight Support Equipment (VIE)

- Vehicle mounted physical interfaces and support equipment such as don/doff fixture, umbilicals, umbilical panel, battery charger, etc.

## Exploration EVA Tools and Equipment

- Equipment used for translation support (handrails, fall arrest, etc), science tasks (rake, sample collection bags, shovel, etc), and construction activities (wrench, drill, scissors, fasteners, etc

# Acronyms

- **CDR –** Critical Design Review
- **CSA –** Canadian Space Agency
- **CLV –** Commercial Launch Vehicle
- **CMV –** Co-manifested Vehicle
- **CWS –** Caution and Warning System
- **DCU –** Display and Control Unit
- **DDT&E –** Design, Development, Test and Evaluation
- **ESA –** European Space Agency
- **GLS** – Gateway Logistics Services
- **HALO –** Habitation and Logistics Outpost
- **HUT –** Hard Upper Torso
- **ISS –** International Space Station
- **JAXA –** Japanese Aerospace Exploration Agency
- **LTA –** Lower Torso Assembly
- **MOU –** Memoranda of Understanding
- **NDS –** NASA Docking System
- **NRHO –** Near Rectilinear Halo Orbit
- **PDR –** Preliminary Design Review
- **PPE –** Power and Propulsion Element
- **RPOD –** Rendezvous, proximity operations and docking
- **SEP –** Solar Electric Propulsion
- **VIE –** Vehicle interface and Flight Support Equipment
- **xEVA –** Exploration Extravehicular Activity System
- **xEMU** – Exploration Extravehicular Mobility Unit
- **xPLSS –** Exploration Portable Life Support Subsystem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