



## HABITATION AND LOGISTICS OUTPOST (HALO)

### Enabling Sustained Lunar Exploration Operations and Destinations Beyond

NASA's Lunar Gateway will serve as a staging point for sustained lunar surface exploration and extensibility towards long-term exploration of the Moon and destinations beyond. The initial Gateway configuration will consist of the Habitation and Logistics Outpost (HALO) module, the Power and Propulsion Element (PPE), a Logistics Module (LM), a Lunar Lander (LL) and the Orion spacecraft.

Northrop Grumman is NASA's contracted partner to build HALO and provide systems integration of HALO and PPE.

#### SPACECRAFT

As the first pressurized element for NASA's lunar Gateway, HALO will be humanity's first permanent home away from Earth. HALO's extensive capabilities will support crew activities that, in conjunction with Gateway, enable sustained operations around the moon, human exploration of the lunar surface, and extended missions

beyond cislunar space. HALO will provide a comfortable, habitable living space that includes science operations, mission sortie preparations, communication with ground and lunar assets, and space for physical exercise equipment. The HALO design leverages extensive human factors testing to provide efficient usage of space, logical crew interfaces, organized cargo stowage, and readily accessible and maintainable equipment.

HALO will provide three docking ports for other modules including the Orion spacecraft, logistics modules, lunar landers, and future modules. Subsystems internal to HALO will monitor, control, and switch the high-power bus that channels energy from the PPE to visiting vehicles and the remainder of Gateway. Network switches housed in HALO will provide high-speed, time-triggered Ethernet communication throughout the module. A fault-tolerant avionics system will control and operate HALO while a thermal control system collects and radiates heat from the module. The Environmental Control and Life Support System (ECLSS) will deliver nitrogen and oxygen to the cabin, controls atmospheric humidity, and provides a contingency capability for the removal of carbon dioxide. HALO's infrastructure also will support internal

and external payloads, ESA's HALO Lunar Communication System (HLCS), and both human and robotic extra-vehicular and intra-vehicular activities.

At the launch site, HALO will be integrated and tested with the PPE. These integrated vehicles are termed the Co-manifested Vehicle, or CMV. The CMV will be launched on a Falcon Heavy launch vehicle from Kennedy Space Center and then use electric propulsion to transit to near rectilinear halo orbit (NRHO) around the moon.

#### FACTS AT-A-GLANCE

- Will support up to four crew with the Orion spacecraft attached for up to 30 days
- 3.0 m diameter module with three docking ports
- Will provide services to both internal and external payloads
- Will feature time-triggered ethernet (TTE) for seamless integration of modules, payloads and subsystem components
- Active thermal rejection system utilizing conformal radiators
- HALO will be integrated with PPE and launched together on a Falcon Heavy Launch Vehicle



# HALO



## INSTRUMENTS OR PAYLOADS

- HLCS – ESA provided communications package, hosted payload, that will provide lunar link between Gateway and the lunar surface and orbiting elements
- HERMES (Heliophysics Environmental and Radiation Measurement Experiment Suite) – mounted externally on HALO, will monitor space weather

## HERITAGE

- Northrop Grumman leverages human space-flight experience gained from Cygnus cargo resupply missions to the International Space Station starting in 2013
- Cygnus, designed and operated by Northrop Grumman, has carried critical crew supplies, equipment and scientific experiments to the ISS under the Commercial Resupply Services (CRS) program
- HALO's primary structure design derives from the Cygnus Pressurized Cargo Module (PCM) and other Thales Alenia Space Italia (TAS-I) designed ISS modules

## FOR MORE INFORMATION

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## MISSION PARTNERS

**NASA JOHNSON SPACE CENTER:** NASA HALO Program Office  
**NASA GLENN RESEARCH CENTER:** NASA Power and Propulsion Element (PPE) Program Office  
**EUROPEAN SPACE AGENCY (ESA):** HALO Lunar Communications System (HLCS)  
**CANADIAN SPACE AGENCY (CSA):** External robotic and payload accommodations  
**JAPAN AEROSPACE EXPLORATION AGENCY (JAXA):** HALO Lithium-Ion Batteries  
**MAXAR:** PPE Provider

## INTEGRATION, TEST, & MANUFACTURING

- HALO primary structure – TAS-I, Turin, Italy
- HALO Test Simulation Facilities – Northrop Grumman, Dulles, VA
- HALO I&T – Northrop Grumman, Gilbert, AZ
- CMV Integration and Launch Site I&T – Cape Canaveral, FL

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