

33rd IAA SYMPOSIUM ON SPACE AND SOCIETY (E5)  
Space Architecture: Habitats, Habitability, and Bases (1)

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DEVELOPMENT OF THE HABITATION AND LOGISTICS OUTPOST MODULE FOR NASA'S  
GATEWAY LUNAR STATION

**Abstract**

The Habitation and Logistics Outpost (HALO) module is the first pressurized element for the National Aeronautics and Space Administration's (NASA) Gateway lunar station. As such, it represents humanity's first long-term home away from the Earth. HALO's extensive capabilities 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 provides a comfortable, habitable living space that enables the performance of all required crew tasks including science operations, lunar sortie preparations, communication with ground and lunar assets, and physical exercise. The cabin's 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 serves as the central node for Gateway by providing three docking ports for other vehicles including the Orion spacecraft, logistics modules, lunar landers, and the International Habitat (I-HAB) that is under development by the European Space Agency (ESA). Subsystems internal to HALO monitor, control, and switch the high-power electrical bus that channels energy from the Power and Propulsion Element (PPE) to visiting vehicles and the remainder of Gateway. Network switches housed in HALO provide high-speed, time-triggered Ethernet communication throughout the station. A fault-tolerant avionics system controls and operates HALO and hosts the Gateway Vehicle System Manager (VSM) software. A thermal control system collects and radiates heat from the module while the Environmental Control and Life Support System (ECLSS) delivers nitrogen and oxygen to the cabin, controls atmospheric humidity, and provides a contingency capability for the removal of carbon dioxide. HALO's infrastructure also supports internal and external payloads, ESA's HALO Lunar Communication System (HLCS), and extra-vehicular and intra-vehicular activities – both human and robotic.

HALO launches on a SpaceX Falcon Heavy launch vehicle in conjunction with the PPE and transits to a Near Rectilinear Halo Orbit (NRHO) around the Moon by leveraging PPE's solar electric propulsion system. Though this transit requires approximately one year to complete, this approach provides an enhanced initial operating capability for Gateway and reduces the interface risks associated with combined PPE and HALO operations.

The design, development, test, and evaluation of HALO along with the integration of HALO and PPE are being conducted by Northrop Grumman under contract to NASA in support of the Artemis Program.