IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Governmental Human Spaceflight Programmes (Overview) (1)

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INTERNATIONAL DEVELOPMENT FOR LUNAR SURFACE HABITATION

Abstract

The National Aeronautics and Space Administration (NASA) is leading an international coalition to the Moon through Artemis, which engages international partners through a shared vision codified in the Artemis Accords. Operations on the lunar surface and in orbit will enable previously uncharted exploration and new scientific discoveries. Operations at the Moon will also serve as an analogue in extreme environments to prove out the technological and operational capabilities needed for future human missions to Mars. Artemis will consist of multiple elements, including the Space Launch System rocket, Orion spacecraft, Gateway lunar space station, Human Landing Systems, surface mobility, and surface habitation. Starting with Artemis III, NASA will begin a cadence of crew landing expeditions near the lunar South Pole, incrementally delivering foundational elements for enduring exploration and research. Lunar surface habitation is key to fostering long-term, human-led exploration and scientific research.

In this highly complex framework, the Italian Space Agency (ASI) is conducting a preliminary design study in cooperation with NASA for the first "Multi-Purpose Habitat" (MPH) to be placed on the lunar surface, aimed at providing crew habitation and interoperability with logistics systems and other lunar infrastructure. The habitat module would constitute a permanent surface asset to house the astronauts, guaranteeing a stable and safe platform for expanding exploration capabilities, carrying out technological and scientific experiments, and collecting significant data on the lunar environment for an operational duration of multiple years, with the possibility of further use thanks to the implementation of active monitoring of the module's health status. The concept proposed relies on highly flexible operational concepts and modular implementation of functionality to enable and enhance lunar surface operations through a building block approach.

To support long term presence on the lunar surface, new technical challenges must be taken and accounted for in habitat design in contrast to orbital infrastructures: lunar gravity effects, lunar dust

impacts on mechanisms and equipment, and severe thermal conditions, particularly during the lunar night. As a permanent module on the lunar surface, MPH must have independent power generation and storage, thermal and environmental control, and communication. To meet the functional needs in the objective timeframe, the MPH architecture will focus on a balanced mix of heritage and innovation. The paper will focus on surface habitation, which will be a key asset supporting lunar operations and achieving a sustained presence on the lunar surface.