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Author: Mr. Jan Persson  
ESTEC, European Space Agency, The Netherlands

Mr. Matias Tarifa  
ESA - European Space Agency, The Netherlands

MOON-TO-MARS: THE OUTLOOK FOR APPLYING ESA GATEWAY TECHNOLOGY TO  
SUPPORT MISSION DESIGN

**Abstract**

The Gateway program to establish an outpost and orbiting platform in Near-Rectilinear Halo Orbit at the Moon forms an opportunity to test technologies and designs that will be essential for crewed missions both to the lunar surface and to destinations further away in the solar system, notably Mars. NASA has worked on a Moon-to-Mars (M2M) point-of-departure design for a deep-space Transit Habitat. ESA contributes to Gateway with I-Hab, the Gateway habitation module, ERM, the Esprit Re-fuelling Module, and HLCS, Halo Lunar Communications System, and the current paper, is meant to take stock of how technology and subsystem elements from these projects represent suitable alternatives for the M2M baseline, thereby presenting options requiring minimum delta development and, as well, a basis for potential European contributions.

For an interplanetary habitation module for a future Mars mission, the crew would need more living space and the M2M baseline contemplates to achieve this by using an lightweight structure for part of the Transit Habitat. Due to launch and other constraints, the final outfitting and commissioning is foreseen to take place while docked to Gateway. The current paper will attempt to weigh the benefit of the novel elements in the Transit Habitat concept against adopting or extending the technologies and designs from I-Hab and other ESA developments, to determine if M2M missions programmatic and technological risks can be reduced. Two examples of I-Hab design elements that correspond to elements in the Transit Habitat baseline are the deployable/articulating radiator and the 3-m metallic cylinder. Additionally, considering that the core of the ECLSS for Gateway is housed in I-Hab and that I-Hab will be ready to be outfitted with regenerative ECLSS, as well as various crew system equipment, I-Hab system engineering can be regarded as precursor for the integrated design effort that will mark the work on both the Surface Habitat and the Transit Habitat in the M2M context.