Ground-Based Preparatory Activities (11)
Ground-Based Preparatory Activities (3) (3)

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THE ESA/DLR LUNA ANALOGUE FACILITY PREPARING FOR LUNAR EXPLORATION: STATUS AND LATEST DEVELOPMENTS

Abstract

As we see the renaissance of lunar exploration, the European Space Agency (ESA) and the German Aerospace Centre (DLR) – co-located in Cologne, Germany – are currently creating a novel lunar analogue facility: LUNA. This unique open-hub for innovation aims at replicating high-fidelity Moon surface conditions on Earth. It will provide access to the full spectrum of lunar surface analogue activities for the exploration community as we prepare for future human and robotic missions.

Europe contributes to the first steps of NASA's Artemis programme with the European Service Module for the Orion spacecraft and Lunar Gateway elements. LUNA will be crucial to design, develop, test, assess, validate and train operational concepts and technologies for sustainable lunar surface activities, including collaboration with astronauts aboard the Gateway and the terrestrial ground teams. Examples include smart systems with easy interfaces as well as progressively increasing automation to address the human-tended operations of both Gateway and future surface elements.

LUNA is expected to grow organically as the developments and needs of the lunar exploration community progress. At the core is a large hall-type structure containing a 700 m2 lunar surface testbed filled with ESA's regolith simulant, EAC-1. At a ceiling height of 9 m, LUNA will allow the deployment of and interaction with larger structures like lunar landers or surface equipment. Variable and adjustable lighting will recreate lunar illumination conditions for surface extravehicular activities (EVAs) and robotic systems operations, including drilling and regolith extraction in specific working sections. An innovative suspension system will allow for immersion into the lunar scenario with reduced gravity by offloading partial weight of astronauts or other systems. The LUNA building will further incorporate a dust chamber and a gas laboratory to investigate regolith handling and hazards as well as resource utilisation aspects, respectively.

Alongside the LUNA building, a habitation module shall be deployed and powered by a stand-alone, off-grid regenerative energy system based on photovoltaics, batteries and hydrogen technology. Additional modules could be envisioned to further enhance the LUNA capabilities. LUNA will complement the existing facilities on the DLR campus, such as the DLR :envihab, the ESA Neutral Buoyancy Facility, and the available control rooms and experienced workforce of the European Astronaut Centre (EAC) and DLR.

This work describes the LUNA facility and its elements in more detail and will provide a status update on the ongoing realisation. The full operational capability of LUNA is expected for early 2022.