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EDEN 2.0 GREENHOUSE DESIGN STUDY IN NEUMAYER-III STATION IN ANTARCTICA

Abstract

Long-term human planetary exploration depends fundamentally on the availability of sustainable life support systems and food supplies. Bioregenerative life-support systems (BLSS) for greenhouses are one of the reliable systems under study today for space missions. This system is capable of producing fresh food for crews by recycling human waste and carbon dioxide, but it also provides psychological comfort by reducing stress for crew members in a remote and isolated environment. The EDEN research team at the German Aerospace Center (DLR) has been working on this concept for several years. As the first prototype of the greenhouse concept, the EDEN ISS MTF (Mobile Test Facility) consisting of two 20-foot-long high cube containers was deployed approximately 400 m from the Neumayer-III (NM-III) station on top of an external platform in Antarctica. This successful MTF resulted in various different projects of test facilities as the next steps, for instance, EDEN NEXT-GEN, EDEN LUNA, and EDEN 2.0. The project EDEN 2.0 aims to build a new greenhouse system inside the NM-III station which can be remotely monitored and controlled by the Mission Control Center in DLR Bremen. Like future planetary greenhouses and habitats, the NM-III station will supply power, water, data, and waste processing. A CE study, a typical collaborative design approach of DLR, for the EDEN 2.0 system design was conducted in 2022 at the CEF in DLR, Bremen. In this paper, we investigate the collaborative design methodology and the current status including design trade-offs of the EDEN 2.0 project. Furthermore, the paper provides the functional analysis, requirements of the greenhouse, and the results of Phase A of the system design. Finally, the paper discusses future milestones and how they will affect the lunar mission.