IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Life Support, habitats and EVA Systems (7)

Author: Dr. Anna Barbara Imhof
Liquifer Systems Group (LSG), Austria

Mrs. Molly Hogle
LIQUIFER Systems Group, Vienna, Austria
Mr. René Waclavicek
LIQUIFER Systems Group, Vienna, Austria
Mr. Robert Davenport
LIQUIFER Systems Group, Vienna, Austria
Mr. Daniel Schubert
Institute of Aerospace Systems, Germany
Mr. Vincent Vrakking
Deutsches Zentrum fuer Luft- und Raumfahrt (DLR), Germany
Mr. Conrad Zeidler
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
Mr. Waltraut Hoheneder
LIQUIFER, Austria
Dr. Volker Maiwald
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
Mr. Paul Zabel
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

GREENHOUSE DESIGN CONCEPTS FOR MOON AND MARS

Abstract

Sustained human presence in space requires the development of new technologies to maintain environmental control, manage waste, to provide water, oxygen and food and to keep astronauts healthy and psychologically fit. Innovative food cultivation technologies in closed-loop life support systems must be developed as an integral part of future space systems.

The paper takes the EDEN ISS project as model to derive architectural surface exploration concepts for the moon and Mars. The goal of EDEN ISS is to advance controlled environment agriculture technologies beyond the state-of-the-art. It focuses on ground demonstration of plant cultivation technologies and their application in space. EDEN ISS developed an advanced nutrient delivery system, a high-performance LED lighting system, a bio-detection and decontamination system, imaging systems for monitoring plant health and technologies for ensuring food quality and safety for integration within a Mobile Test Facility (MTF).

The Mobile Test Facility is currently located at the Neumayer III Antarctic station, operated by the Alfred-Wegener-Institute, and is serving as an analogue environment for testing plant cultivation under extreme environmental and logistical conditions. The EDEN ISS MTF has successfully been tested for the winter 2018/19 and the research contract has been renewed for another two winters until 2021.

Antarctica serves as an excellent analogue for preparing missions in extreme environments on extra-terrestrial surfaces. The lessons learnt from EDEN ISS overwintering in Antarctica are incorporated into the design scenarios and applications for the lunar and Martian surface. In a Concurrent Engineering

Facility (CEF) partners of the EDEN ISS consortium came together to study exploration greenhouse designs using inflatable habitat technology.

The paper will show the methodology how concepts from the EDEN ISS simulation facility in Antarctica can be derived for moon and Mars, and it will describe the layout concepts for the greenhouse envelope including interior configuration options. The inflatable design comprises a longitudinal geometry with rigid cones and a growth and shelf system that functions similar to the MTF in Antarctica. Differences and similarities of the proposed space designs, outcomes and learnings from running the facility for more than one year throughout the Antarctic winter and how these are incorporated into the designs, will be the focus of the paper. Finally, the relevance of building and testing simulation prototypes in preparation for designing future space exploration missions will be demonstrated.