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Architecture for humans in space: design, engineering, concepts and mission planning (1)

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THE EDEN ISS ANTARCTIC GREENHOUSE PROJECT – FINAL DESIGN AND OUTCOME OF
THE ASSEMBLY, INTEGRATION AND TESTING PHASE**Abstract**

The international EDEN ISS project aims to develop and validate technology as well as investigate food safety and plant handling procedures for higher plant cultivation. Such technology, science and operational protocols are important for bioregenerative life support systems suitable for use on orbit as well as within future Moon and Mars habitats. Following the project kick-off meeting in March 2015, the project consortium designed, built and tested a greenhouse module called the EDEN ISS Mobile Test Facility. The facility consists of two modified 20 foot shipping containers to facilitate transport using nominal logistics chains. One of the containers houses the Service Section with all subsystem components required for maintaining proper environmental conditions, nutrient solution parameters and illumination settings for optimal crop growth in the second container – the Future Exploration Greenhouse. In addition to the subsystem components of the Air Management System, Nutrient Delivery System, Thermal Control System, Power and Control System, a rack-sized plant cultivation system, which uses a standard International Space Station payload form factor, is also integrated in the Service Section container. Plant species varying from leafy greens (e.g. lettuce, herbs) to tall growing plants (e.g. tomato, cucumber) are grown in the Future Exploration Greenhouse. On a cultivation area of roughly 12.5 m, plants are cultivated on up to four levels under water-cooled LED lamps in customized growth trays using a hydroponic irrigation system. This paper provides an overview of the final design and all activities performed during the assembly, integration and testing phase of the Mobile Test Facility. Detailed information regarding the timeline and lessons learned during the AIT project phase are presented in the paper. A summary of the leakage, acoustic and plant growth trials and other tests conducted in Bremen are described. Following the test phase, the facility will be prepared for shipment and arrive in Antarctica by ship in December 2017 and commence its 12 month or longer space analogue mission at the highly-isolated German Antarctic Neumayer Station III.