Paper ID: 87582
oral
student

IAF SPACE POWER SYMPOSIUM (C3)
Space Power Systems for Ambitious Missions (4)

Author: Mr. Denis Michael Acker
Institute of Space Systems, University of Stuttgart, Germany

Mr. Claudiu Mortan
University of Stuttgart, Germany
Ms. Diana ALjbour
Space Generation Advisory Council (SGAC), Jordan
Mr. Karthik R Varma
Space Generation Advisory Council (SGAC), India
Mr. Sreekar Pullabhatla
Space Generation Advisory Council (SGAC), India
Ms. Drishana Jhunjhunwalla
Space Generation Advisory Council (SGAC), India
Ms. Katherine Zamudio-Turcotte
Polytechnique Montreal, Canada
Mr. Damien Gonfo
Space Generation Advisory Council (SGAC), France
Ms. Dhanisha Sateesh
Pixxel Space Technologies, India
Dr. Charleston Dale Ambatali
University of the Philippines Diliman, The Philippines
Mr. Prishit Modi
University of Stuttgart, Germany
Mr. Daniel Wischert
European Space Agency (ESA), The Netherlands
Ms. Elizabeth Gutierrez
University of Stuttgart, Germany

THE ZEUS CONSTELLATION: PAVING THE WAY TO SUSTAINABILITY ON THE MOON WITH SOLAR POWER SATELLITES

Abstract

Providing power to support extensive lunar In-Situ Resource Utilization (ISRU) operations is a significant challenge, especially in polar regions with irregular solar illumination. Existing energy generation technologies, such as terrestrial solar modules and fission reactors, fail to meet the energy demands of substantial lunar infrastructure concepts. The irregular solar radiation in the southern polar regions further exacerbates the challenge.

In order to meet the reliability requirements necessary for lunar operations, including energy availability throughout day and night cycles, implementing a constellation of Space-Based Solar Power (SBSP) satellites is a promising solution to provide continuous power for lunar night survival. ZEUS is a satellite constellation designed to harvest solar power and transmit it wirelessly to the DIANA (Dedicated Infrastructure and Architecture for Near Earth Astronautics) lunar village. The network of satellites shall

enable the operation of ISRU facilities on the lunar South Pole and advance the prospects of long-term lunar exploration and utilization.

The research will propose the design and development activities of the ZEUS satellite constellation with a focus on photovoltaic energy generation and wireless power transmission. The mission analysis and the subsequent spacecraft design will transfer traditional Earth-centered satellite design methods to create a unique SBSP constellation. They will address challenges posed by the same, especially in terms of power transfer, thermal control, energy generation, and storage. The study will also investigate the pointing requirements of wireless power transfer between the constellation and the lunar infrastructure. Furthermore, an evolutionary design approach involving the use of lunar resources for structural components of the satellites will be considered.

The study, conducted by members of the Space Generation Advisory Council (SGAC) within the Small Satellites Project Group (SSPG), will address the power limitations associated with the ISRU activities on the lunar South Pole and provide an SBSP solution. The successful integration into the framework of a lunar ISRU village will support the vision of a self-sustaining lunar facility for long-term lunar exploration efforts.