

SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies and Concepts (3)

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FUEL CELL DESIGN AND BREADBOARDING ACTIVITIES FOR LUNAR SURFACE
APPLICATIONS

Abstract

The provision of energy for the operations of future elements, used in both manned and robotic Exploration Missions, is of vital importance for the success of these missions. A great effort has been done in the last years in order to identify the most suitable power system architectures and the related critical technologies to be developed, in order to reply in an effective way to the very demanding operational requirements. The complexity of this task is increased by the need of providing the required power levels in very different environmental conditions, like the ones experienced for example during the interplanetary space transportation, or during the surface operations on the planned exploration targets, like Moon or Mars, and even in critical situations, like the ones experienced when the intensity of solar radiation is extremely low or absent. Among several promising technologies, the Fuel Cells Technology is considered one of the best and most effective candidate to be implemented in future energy and power provision systems. The paper addresses the findings of an ESA study, performed by an Italian consortium led by CGS, and aimed at designing and breadboarding a new type of Energy Provision and Management system, based on advanced Proton Exchange Membrane Fuel Cells, developed for supporting Space Exploration applications, specifically on lunar surface. The paper covers all the key phases of the Study, from the requirements identification, the technological trade-offs, the development of two highly synergetic designs for both a fixed relocatable installation to be used as a power plant for different users and the subsystem of a Pressurized Rover, up to the development of a Technological Demonstrator (at TRL 4-5) and the related test campaign results. Moreover, it reports also clear technology development roadmap for the further improvement of such capabilities in Europe, in synergy with other mission scenarios and terrestrial applications, considering the costs and benefits of a broader innovation potential associated to their development.