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SYSTEM ARCHITECTURE FOR POWER GENERATION, MANAGEMENT AND MAINTENANCE OF A NUCLEAR PLANT ON THE LUNAR SURFACE FOR IN-SITU RESOURCES UTILIZATION

Abstract

The future of space exploration relies upon refuelling of useful resources, such as propellant, water and oxygen, along the space segment. A concept envisioned by the Global Exploration Roadmap is to extract raw materials from the Lunar surface and refine them in-situ, thus providing useful resources directly on lunar environment. The architectures adopted to produce and manage electrical power during present space exploration missions cannot provide an efficient and cost-effective solution for this application. Moreover, the involvement of a large crew in a permanent moon village drives the design in terms of safety, power distribution and management. Thus, innovative solutions have to be derived to fulfil these demanding requirements.

This paper presents the system architecture for generating and distributing nuclear electric power on the Lunar surface. The analysis starts from the LUnar Propellant Outpost (LUPO) mission architecture presented during IAC 2018. For this second iteration, a large augmentation of the production on the ISRU facilities was proposed. Moreover, LUPO mission architecture requires a continuous production of resources even during the long polar night, imposing a power source independent form the solar energy. Finally, a significant increase of the permanent crew on surface has been proposed, leading to important evaluations on safety and reliability of the system. A trade-off analysis was performed to select the most efficient solution with respect to safety, cost-effectiveness and reliability of the whole power system. Here, an overview of the selected system architecture is described. Special attention is provided to the integration on the LUPO mission, with respect to the robotic maintenance of the power plant and compatibility with a large crew in a permanent moon village.

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