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REGENERATIVE FUEL CELL SYSTEM (RFCS) FOR ENERGY STORAGE AND PROVISION DURING LUNAR NIGHT SURVIVAL

Abstract

The Argonaut - European Large Logistic Lander (EL3) program is an ESA initiative to provide independent access to the Moon for Europe while contributing to near-term future international lunar exploration efforts. Two potential mission concepts are being considered: a Cargo Mission for logistics delivery to the lunar surface to support future human missions and a 'Polar Explorer' Mission aimed at landing scientific and technology payloads at the lunar South Pole. The European Ariane 6 launcher vehicle is the target launcher for these missions. For lunar night survival, a large amount of electric energy has to be stored before the lunar night begins. Regenerative Fuel Cell System (RFCS) is an ideal solution to meet these specific energy requirements, offering increased specific energy when compared to batteries with the advantage of autonomous thermal energy management. A regenerative fuel cell system can operate in two modes: Fuel Cell and Electrolyzer. During the fuel cell mode, the fuel cell stack takes in the fuel and oxidizer and converts them into electricity, while the electrolyzer stack remains inactive. During the electrolyzer mode, the electrolyzer stack uses the electrical energy to split water into hydrogen and oxygen, which can be stored and later used as fuel. In a recent activity, where a TRL4 RFCS has been developed, many challenges have been encountered, such as sensor reliability, material compatibility and reactant pollution. Lessons learned in this project will guide the development of a TRL5 version of the RFCS where the optimization of reliability and performance (400 Wh/kg and 50