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REVIEW AND EVALUATION OF ENERGY GENERATION SYSTEMS FOR PLANETARY SETTLEMENTS

Abstract

Several space agencies and private and academic entities are currently working in different aspects of future human space exploration and settlements in space. One key element for the development of such facilities will be energy, in terms of its generation, storage, distribution, and usage. Space conditions, in particular, those of the Moon and Mars, impose restrictions to the implementation of some of the traditional energy generation methods on Earth, which has led to the development and use of alternatives such as solar panels and nuclear thermoelectric generation. For future human settlements, redundancy will be fundamental, apart from systems such as Oxygen generation and heating that have a brief natural buffer, electric supply is key for a station. It is important to consider the fact, within varying architectures, that different systems are vulnerable to different phenomena, and can endanger the mission, as recently happened to the Mars Rover Opportunity. This work presents the different current options for energy generation for human settlements in planetary surfaces. Three topics were reviewed for this work, first, the size of energy requirements on a planetary station is made, as well as a prospect for usage distribution, including life support systems, research systems, and future systems for in situ manufacturing, among others. Second, energy systems used currently and in the past, with their possible expansion towards the future, and their usability in Moon and Mars missions, stating their advantages, as well as their vulnerabilities. Next, future concepts for space energy generation -understood as systems that have not been used on space broadly or are currently prototypes or concepts- are also presented. Finally, a parametric measurement is proposed, considering metrics such as capacity, complexity, required maintenance, in order to generate a viable comparison, which would allow for an easier selection of systems within architectures for planetary stations. As a result, this review brings together a panorama of the alternatives for the development of space architecture concepts for future settlements on planetary surfaces.