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EVOLUTION OF THE PERFORMANCE MONITORING TECHNIQUES FOR SOLAR ARRAYS OF THE SERVICE MODULE ZVEZDA WITHIN THE ISS RUSSIAN SEGMENT OVER THE COURSE OF ITS ORBITAL FLIGHT

Abstract

The paper discusses issues involved in mission control of Manned Space Complexes (MSC), in particular, specific aspects of monitoring and evaluating the status of Power Supply Systems (PSS) and solar arrays as their components. Power budget simulations use as their initial computational parameter the current SA performance, which is determined on the basis of a special performance evaluation mode. The obtained data make it possible to take into account the spaceflight factors resulting in performance degradation. Besides that, when using the SA performance evaluation mode as a method for periodically checking the SA status, the more accurate determination of the actual SA performance involves taking into account the shadowing of the photovoltaic cells, the effect of the light reflected off the Earth surface, and current generation resulting from illumination of both the front and the back surfaces of the SA. The paper presents the results of space experiment Albedo carried out onboard the ISS RS, which included development of techniques for taking into account the above factors when simulating the PSS power budget for the Service Module (SM) Zvezda of the Russian Segment of the International Space Station (ISS RS). Developed as a result of carrying out the space experiment was a procedure for determining SA performance and simulating the power input from the ISS RS SM SA taking into account the Earth albedo; recommendations were made for the orbital spacecraft PSS control modes taking into account the possibility of power generation from the Earth outgoing light flux. Based on the results of testing the developed computational schemes for evaluating the SA performance and simulations of incoming power that take into account the Earth albedo, substantiated values were obtained for the proposed reference parameter for evaluating the ISS RS SM SA. The developed procedure provides the most accurate performance evaluation for both front and back surfaces of the SA. Computational schemes for predicting incoming power proposed within the framework of the procedure make it possible to give highly accurate predictions of incoming power using precise simulations of light flux coming from Earth, as well as to determine the contribution of variable components into the SA performance determined during a periodic SA performance estimate. The proposed procedure can be used to make predictions and monitor solar arrays performance during SC flight in both near-Earth and circumlunar orbits.