

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

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MODULE ENERGY BALANCE MATHEMATICAL MODELING COMPLEX

**Abstract**

The description of the Multipurpose laboratory module (MLM) Energy balance mathematical modeling complex is provided in this report. The Complex is being developed for the correct MLM Electrical power supply system (EPS) status predicting and the guaranteed MLM onboard equipment electricity supplying in every phase of its flight. The Complex will be used in software and hardware tools for the Main operative control team specialists work station. The Complex is being designed to simulate the EPS MLM status and to assess the flight possibility for a given phase of flight in terms of MLM energy supplying. The arrangement and functioning of the EPS MLM are briefly explained. The structure of the Complex and its difference from the used Service module mathematical energy balance model are in detail described. The Complex is implemented in several software modules:

- solar array power generation prediction module;
- on-board systems power consumption prediction module;
- EPS MLM as an automatic control system modeling module;
- storing the simulation results database;
- simulation data from the database and actual data from the telemetry stream congruence module;
- all the software modules gathering integration module.

The principal difference from the Service module software is entering the Congruence module and the Database into the Complex. The special attention is given to these software modules. The Congruence module must provide the automatic comparing of the EPS MLM status simulation results calculated by the Complex and the actual system status, obtained by the telemetry information during the flight plan realization. The Database must collect, store, update, search, process and display the modeling results information in a suitable format. Inputting of these two modules would allow us to:

- identify the possible Solar Arrays efficiency changing quickly by comparing predicted and actual currents;
- use the simulation results by the analysis of possible contingencies in the EPS;
- correct the consumption values of the MLM equipment in the consumption forecast module.

Today the number of management objects orbiting Earth is increasing, and as the result, the number of telemetry streams is increasing too. The Complex will save the operator from the routine telemetry analysis and improve the flight control reliability. This task becomes more and more actual now. The Complex real time testing will allow us to use similar software solutions for the Service Module and future International Space Station Russian Segment modules.