IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Flight & Ground Operations aspects of Human Spaceflight - Joint Session of the IAF Human Spaceflight and IAF Space Operations Symposia (4-B6.4)

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ANALYSIS OF THE PLANS OF RESEARCH EXPERIMENTS ON 'PROGRESS' CARGO VEHICLES

Abstract

Russian 'Progress' cargo vehicles are an indispensable platform for space experiments performance. It makes sense to use them for this purpose not only from the standpoint of their engineering capabilities but also from the economic standpoint. It is due to significant residual resources to continue orbital operations after completing that phase of their mission where they stay attached to the space station. To perform research experiments using the 'Progress' cargo vehicle in its free flight after undocking from the station the following major areas could be considered: - Development and in-flight testing of various hardware, methods and systems. Based on technologies developed onboard the cargo vehicle, specialized spacecraft can be built to address various practical tasks; - Earth surface observation. Conducting observations and imaging during free flight of the cargo vehicle makes it possible to increase significantly the total volume of information received within the program of ground objects observation while constrained by available energy resources; - Experiments on microgravity onboard the cargo vehicle, as well as providing other special environment for space experiments. There are no crew and no life support systems onboard the cargo vehicle and micro-accelerations in it are significantly lower than in the ISS Russian Segment. Favorable conditions for microgravity space experiments are provided by passive attitude modes of the cargo vehicle. Special equipment additionally installed on the cargo vehicle makes it possible to provide conditions required for space experiments both inside the vehicle and outside it; - Studies of the upper atmosphere using a tethered system based on the 'Progress' cargo vehicle. The proposed plan of the experiment allows to conduct long-term study of the upper atmosphere layers (100160 km) during the slow orbital descent of the cargo vehicle without expending any energy to maintain flight in the upper atmosphere. Reliable deployment of the tether is provided by aerodynamic stabilization of the probe and by application of the force pointed towards the Earth; - Launch of the satellites after the cargo vehicle undocking and departure from the ISS. To launch satellites it makes sense to move the 'Progress' cargo vehicle after its undocking to a higher orbit. For this purpose, the satellite is located inside the 'Progress' cargo vehicle in a special launch container. After the cargo vehicle undocking and transfer to the higher orbit, the satellite separates from the vehicle and starts its autonomous flight in orbit. If the satellite has any deployable structural elements, which require operator control for their perfect deployment, it is proposed to place the satellite inside the cargo vehicle in stowed configuration. After the cargo vehicle docking to the ISS, the satellite is transferred into the station and during a spacewalk is installed by the crew on the cargo vehicle hull assuring all the necessary interfaces. The paper discusses and details the plans of experiments performed in free flight of the 'Progress' cargo vehicle and addresses the issues of the development and construction of the scientific equipment for these experiments.