AEROSPACE EDUCATION PROGRAM REALIZATION BY MEANS OF THE MICRO-SATELLITE

Stanislav I. Klimov\textsuperscript{1,2}, Gennady M. Tamkovich\textsuperscript{1,2}, Vadim N. Angarov\textsuperscript{1,2}, Yuri I. Grigoriev\textsuperscript{1,3}, Oleg R. Grigoryan\textsuperscript{1,4}, Mikhail B. Dobriyan\textsuperscript{1,2}, Mikhail N. Nozdrachev\textsuperscript{1,2}, Alexander P. Papkov\textsuperscript{1,5}, Igor V. Pharmakeev\textsuperscript{1,6}, Vladimir V. Radchenko\textsuperscript{1,4}, Sergei I. Vasiliev\textsuperscript{1,3}, Lev M. Zelenyi\textsuperscript{1,2}

\textsuperscript{1)Interregional public organization "Microsputnik", Profsoznaya 84/32, 117997 Moscow, Russia; Phone: +7 095 333 3077, Fax: +7 095 333 3077, microsat@iki.rssi.ru ; \textsuperscript{2)Space Research Institute of RAS, Profsoznaya 84/32, 117997 Moscow, Russia, Phone: +7 095 333 1100, Fax: +7 095 333 1248, sklimov@iki.rssi.ru ; \textsuperscript{3)Rocket-Space Corporation “Energi”, Korolev, Russia Phone/Fax: +7 095 333 3077, \textsuperscript{4)Institute of Nuclear Physics, Moscow Sate University, Vorob’evy Gory, 119992, Moscow, Russia, Phone: +7 095 939 5061, Fax: +7 095 939 0896, orgri@srd.sinp.msu.ru ; \textsuperscript{5)Research Laboratoty of ROSTO, group PLIS, Kaluga, Russia, Phone/Fax: +7 0842 558 174, plis@kaluga.ru ; \textsuperscript{6)Physical-technical school, Obninsk, Russia, Phone/Fax: +7 08439 63 488, farnakeev@obninsk.org

ABSTRACT

The aerospace education is the basic task of the Program (PSEMS’ 2002-2007) of the Scientific - Educational Micro-Satellite (SEMS) pursues solely humane objectives associated with directional evolution of interests of the students and extension of knowledge in a selected area through a wide use of experimentally received space information, the use of space and computer technologies. The main objective of the PSEMS is to introduce new high-efficient method of education of schoolchildren and students based on the development, launch of satellites and their use through School Centre of Reception of the telemetering Information (SCRI), data receiving, processing and physical interpretation. Cosmonautics as a field of science and technology is a unique area of research and educational activity where interests of actually all branches of scientific knowledge cross. The PSEMS solves the tasks in three directions – educational, scientific, technical – and is based on sequential evolution of tasks in all directions – from a simple to a more complex one. The PSEMS is not commercial: it does not pursue deriving a profit. Money received from the PSEMS implementation will be invested to projects of new satellites, new research programs and development of logistics base of organizations involved in the activities.

1. INTRODUCTION

Orientation of the PSEMS of development and use of micro-satellites (MS) in the interests of science and education - «Space to Youth, Youth to Space» is unique in world practice [1]. Solution of scientific, technical and educational tasks of the PSEMS makes possible development of a long-term space educational system for youth based
on interactive cognition of the most comprehensive component of environmental activity – Space.

New generations can be taught to think on a global-, space-wide scale, not confining oneself to a circle of narrow tasks. Such complex field of activity as space research and development gives such a possibility and allows one to find application to inclinations and interests of any one being taught, making them more profound and extended. Space exploration allows one to bring together the diversity of knowledge from different fields both the humanities and engineering.

Introduction of virtual aids to the modern education process, when actual processes are modeled on computer monitors, narrows the picture of perception of the environment – the picture on the monitor will never replace a lively contact with nature, actual physical processes. A learner prefers wants to touch what he studies. Therefore, the need for use of visual aids and laboratory experiments in the educational process is not fallen away and is very useful as before. A SEMS in combination with the SCRI becomes just such modern visual aids: operational, versatile, popular, global ones that make the process of getting knowledge more profitable and substantially efficient as a whole.

2. MAIN PRINCIPLES OF THE PSEMS

OPENNESS. The PSEMS is open for state, public organizations and private persons. The use of radio-amateur communication channels and Internet opens wide possibilities and easy access of the students to the PSEMS.

THOROUGHLYNESS. The PSEMS sets real and urgent humane and scientific and technical tasks that are important for development of modern sciences about the Human, Earth and Universe. A wide coverage of the students by the PSEMS activities is combined with serious approach to space exploration and adaptation of scientific and technical methods to the educational process and the use of achievements of space and computer technologies in the interests of space education.

ACCESSIBILITY. The methodology of the PSEMS projects development pays special attention to preparation of education questions with regard to base knowledge of the students allowing, if necessary, extended study of selected subjects and observance of the principle “from a simple to a complex one” with sequential and stepwise buildup of the knowledge scope.

3. “KOLIBRI-1” – THE PSEMS BASE PROJECT

The launch of the Russian-Australian SEMS “Kolibri-2000” (“Kolibri-1”) on November 26, 2001 became the first PSEMS project [2]. The SEMS was delivered to the International Space Station by the Progress cargo vehicle. In the night from the 19th into the 20th of March 2002, after four-month duration of stay aboard the International Space Station, the SEMS was injected into an independent orbit after separation of the Progress. The “Kolibri-2000” performed 711 orbits around the Earth, and in the morning on May 4, 2002, terminated its life in the upper atmosphere above the Pacific Ocean area. The analysis of the results of the first satellite flight confirmed completely
the prospects of the PSEMS implementation and gave grounds to use the “Kolibri-2000” satellite as a base one for the whole series of the SEMS [3]

4. PHASES OF THE PSEMS

The condition for beginning of work on development of the second and following MS is the guarantee of financial support of the main phase of the PSEMS. Under favorable conditions the duration of the main phase of the PSEMS can be increased.

<table>
<thead>
<tr>
<th>ON FLIGHT SERTIFICATION TEST</th>
<th>INITIAL PHASE OF THE PROGRAM</th>
<th>MAIN PHASE OF THE PROGRAM</th>
<th>COMPLETE PHASE OF THE PROGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEVELOPMENT AND FLIGHT TESTS OF A BASE MS</td>
<td>DEVELOPMENT OF THE 2nd MS AND START OF DEVELOPMENT OF THE 3rd MS (PRIOR TO LAUNCH OF THE 2nd ONE)</td>
<td>PARALLEL DEVELOPMENT AND OPERATION OF THE MS</td>
<td>COMPLETION OF DEVELOPMENT OF THE LAST MS AND ITS FLIGHT</td>
</tr>
</tbody>
</table>

2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007

5. INPUT PROVISIONS FOR DEVELOPMENT OF THE PSEMS AS A WHOLE

The PSEMS consists of continuous activity in space education area, as well implementation of five projects of development and flight of micro-satellites in the interests of science and perfection of space education.

- Each project solves a part of tasks on implementation of educational and scientific activity. It includes creation (design, manufacture, assembly and tests) and operation (flight) of one micro-satellite.
- The first project – the “Kolibri-1” – implemented in 2002 is the base one for adoption of methodical, design and system decisions, as well as development tests of the main methods of the PSEMS implementation.
- Implementation of the following four projects (beginning from the second one) shall, as possible, provide continuity of satellite flights with consideration of the orbit-delivery capabilities of launch vehicles.

The research and educational, engineering-technical and production potential accumulated for the Program implementation assumes simultaneous operation under two-three projects on development of micro-satellites and under two projects during their implementation.
6. PROGRAM FINANCING SOURCES

It is assumed that different sources of Program financing will be used as a whole, the “Kolibri-2” project is also included:

- A partial state financing on research areas of Rosaviakosmos, Minpromnauka, Ministry of Education and other departments (with total expenditures for all projects of no more than 30%);
- Separate resources allocated for target federal and regional programs on agreement;
- Separate resources allocated by territory administrations on agreement;
- Resources of state and non-state funds (RFBR, MNTTs, FPK, Gorbachev fund and others);
- Sale and leasing of ground stations of date reception and processing;
- Offering subscriptions for reception of data on a micro-satellite;
- Attraction of investors, including ones for implementation of commercial ground projects associated with the Program implementation;
- Attraction of co-authors and associative participants, whom additional services such as participation in flight program formation, determination of priorities in scientific data transmission are rendered to;

Resources received from charitable actions and other.

7. REFERENCES