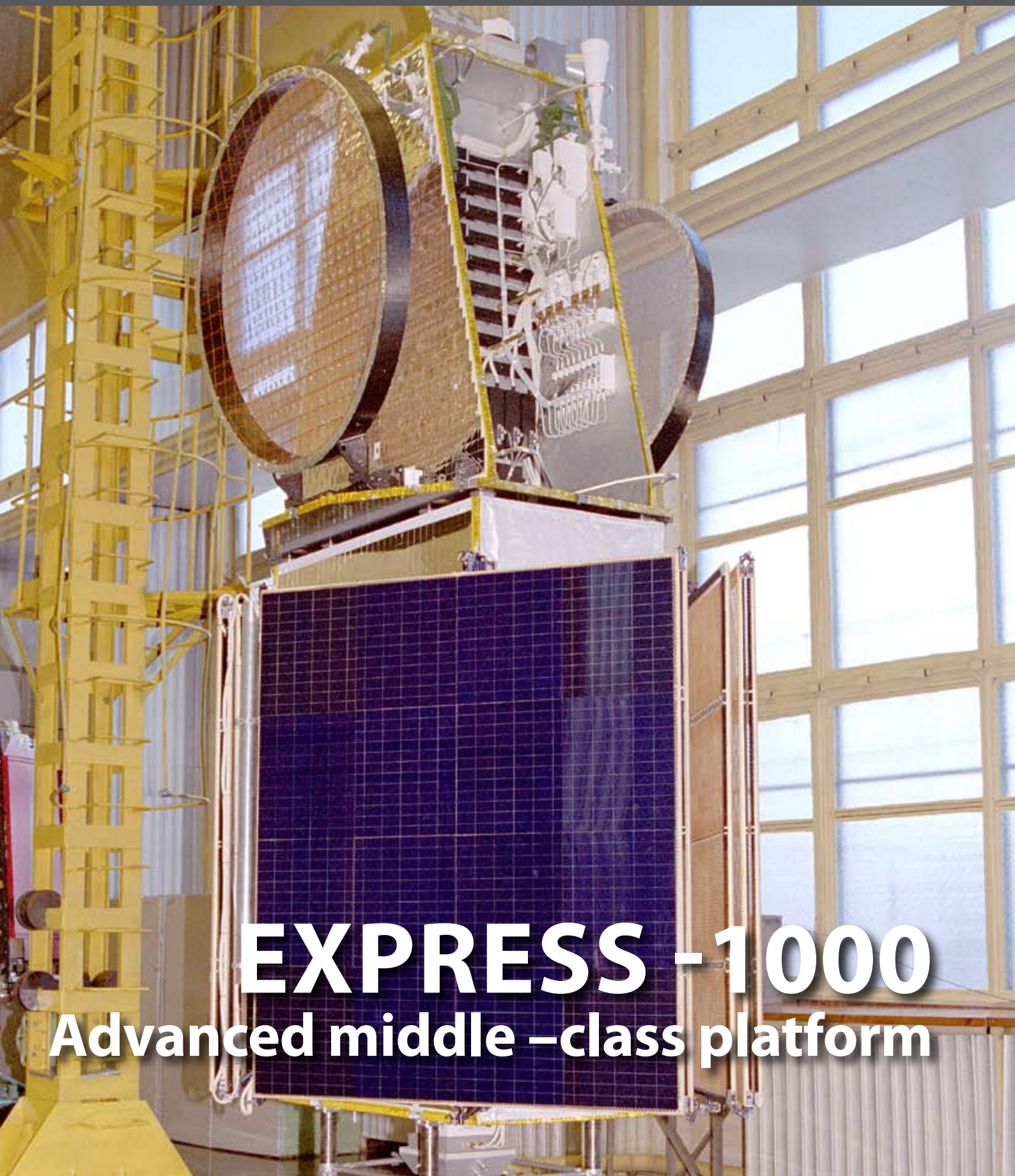
RESHETNEV
COMPANY

INFORMATION
SATELLITE
SYSTEMS

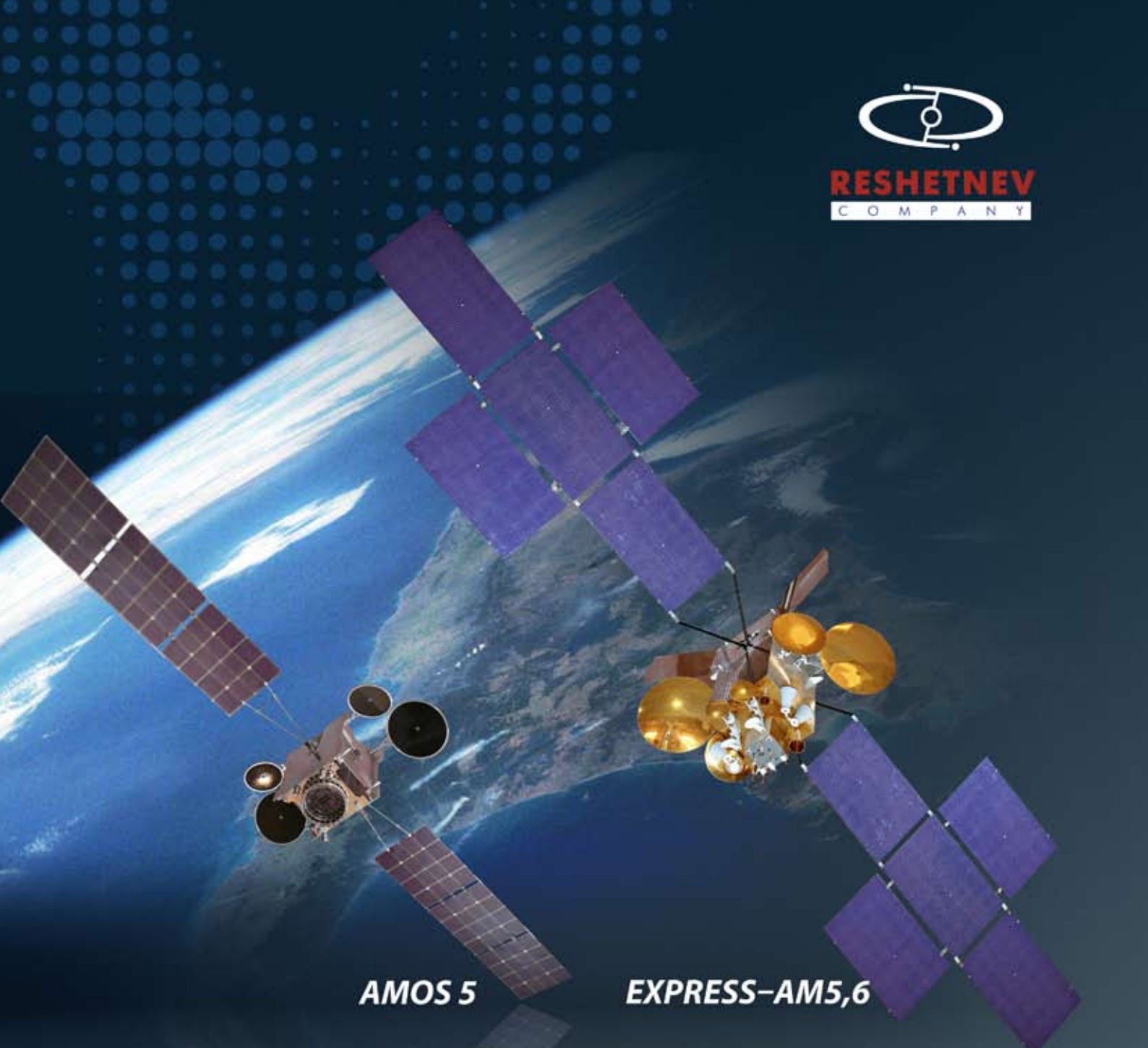
№7, 2009



EXPRESS -1000

Advanced middle –class platform

RESHETNEV
COMPANY



AMOS 5

EXPRESS–AM5,6

LONG –TERM DEVELOPMENT

Dear colleagues and partners!

Today Russia's space activity is one of the major lines of the country's development. Communication, navigation, geodesy, telecommunications and the country's defence capability are all provided by satellites manufactured by the JSC "Academician M.F. Reshetnev "Information Satellite Systems".

On June 4, 2009 the ISS celebrated its 50th anniversary. By the start of the year the company had made a number of significant achievements within the framework of the Federal Space Program, the GLONASS Federal Target Program and the Government's Defence Order. The major federal programs are being financed by the Government. The company has also initiated work on the foreign commercial projects, in particular, AMOS 5 and TELKOM 3.

Within the framework of the Federal Space Program, the JSC "ISS" is proceeding with the manufacture of the multifunctional space relay system, Loutch, based on the next-generation data relay satellites of unpressurized design, with the service life exceeding 10 years. This is another important, evolutionary and revolutionary advance in the satellite system development, generating improved performance characteristics, which will enable continuous observation of low-altitude objects by three data relay satellites placed in their designated positions.

On the whole, the ISS's volume of production is expected to increase by 40% in 2009, which is a sound guarantee of the company's social and financial welfare. Besides, the number of the ISS employees gradually increases due to the on-going purpose-oriented training program and the intake of students made to satisfy the Defence Order.

When setting ambitious targets of creating new-day space technology and machinery, which involves a significant increase in production, the enterprise has no right for a mistake. I am certain that the company's personnel will meet all the targets and triumph over difficulties, gaining invaluable experience for further successful work.

.....

Nikolai A. TESTOEDOV,
general director and general designer.

RESHETNEV
COMPANY

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The JSC "Academician M.F. Reshetnev "Information Satellite Systems"

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Information period:
April – May 2009

References to our information are mandatory.

Printed at the JSC "ISS"
Circulation: 999 copies.
Distributed free of charge.

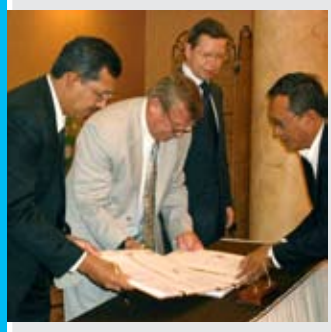
CONTENT

Three Glonass-M satellites put into operation

The mission to inject three new satellites manufactured by the JSC "Academician M.F. Reshetnev "Information Satellite Systems" into the GLONASS system is complete in full accordance with the flight program.

The three Glonass-M navigation satellites (#27, 28, 29), launched on December 25th, 2008, were put into operation by the end of February. In accordance with the approved schedule, upon completion of the orbit correction phase the satellites were placed into the designated orbital positions. Then, the satellite navigation equipment was activated. The commissioning of the three Glonass-M satellites provided 100% coverage of the Russian Federation territory with navigation signals. Thus, the JSC "ISS" fulfilled its obligations set for 2008 under the GLONASS Federal Target Program.

The new international contract of the Reshetnev Company



The JSC "Academician M.F. Reshetnev "Information Satellite Systems" has entered into a contract with the Indonesian satellite communications service provider, PT Telekomunikasi Indonesia Tbk, to build a telecommunications satellite, TELKOM-3.

The new satellite will be manufactured on the Express-1000H platform by the JSC "ISS". The company will also produce a ground control segment and provide training services and satellite in-orbit operation support. The spacecraft is to be launched in August, 2011. The main subcontractor is the French branch of Thales Alenia Space. The satellite service areas are Indonesia, Malaysia and South-East Asia.

JSC "ISS" will create new communications satellites

JSC "Academician M.F. Reshetnev "Information Satellite Systems" is the winner of the open tender for procurement of the Express-AM5 and Express-AM6 satellites.

In accordance with the tender conditions, the state contract for the procurement of the satellites will be concluded by the Russian Satellite Communications Company and the JSC "ISS" within 90 days after the tender results have been announced. According to the contract, the Reshetnev company is responsible for design, development, manufacture, testing and preparation for launch and in-orbit commissioning of the Express-AM5 and Express-AM6 telecommunications satellites. The new heavy-class telecommunications satellites are three times as powerful as satellites of the previous generation. Power allocated for the satellite payloads will be 14 kW, as minimum. Each satellite will carry transponders in C, Ku, Ka and L-bands. Their launches are scheduled for 2012.

Federal funds for re-equipment

The JSC "Academician M.F. Reshetnev "Information Satellite Systems" will receive state budget financing to reconstruct and re-equip the production and experimental facilities to enable the Glonass-K spacecraft production.

The finance is provided under the GLONASS Federal Target Program. The reconstruction activities include the renewal of the existing production and experimental facilities, procurement of advanced metal-working machinery and reconstruction of the utilities systems. A significant amount of funds will be allocated to the creation and equipment of the electrochemical workshop which will combine electroplating and varnish-and-paint operations.

COOPERATION

DREAMS COME TRUE

The Council of Chief Designers held in early March at the JSC "Academician M.F. Reshetnev "Information Satellite Systems" confirmed that the plans for the manufacture of advanced satellites devised several years ago are being successfully realized. As a result, the company's yields are new contracts, increased production output and project financing.

Nikolai A. Testoedov:
'16 satellites manufactured by the JSC "ISS" will be launched into orbit in 2009'

A regular Council of Chief Designers under the chairmanship of Nikolai Testoedov, the general designer and general director, was held at the JSC "ISS" on 4-5 March and brought together more than 120 representatives of the customers and other enterprises of the Russian space industry.

Due to the teamwork all the enterprises involved in satellite-building cooperation are now loaded up with work for the next few years. First of all it is related to the state and commercial projects which are based on the ISS's advanced unpressurized platforms.

One of the Council's prime tasks was to determine a scope of work on the development of the advanced satellite platform, Express-4000. 'It is a unique new-day platform, which will allow us to manufacture the best satellites in Europe', declared Nikolai Testoedov at the press conference regarding the results of the Council meeting.

Another subject for the Council to discuss was the replenishment and modernization of the GLONASS orbital constellation. By the Resolution of the Government of the Russian Federation regarding the GLONASS Federal Target Program the financing of the program was increased by 67 billion roubles. It was caused by the necessity of launching another eleven Glonass-M satellites to maintain the nominal condition for the current orbital constellation while the new Glonass-K satellite was being developed and tested. The program is now being implemented and the financing is allocated to the full scope.

The company aims to replenish the orbital constellation with 16 satellites in the current year. With this issue on the agenda, the Council considered and coordinated all the work to be carried out to perform the scheduled launches.The milestones of the Federal Space Program were also considered.

During the Council meeting the members discussed issues related to the implementation of the AMOS 5 project. Thus, according to Nikolai Testoedov, good progress has been recently achieved within the framework of the Russian-Israeli project: the ISS has entered into contracts with all subcontractors and now is elaborating equipment design documen-

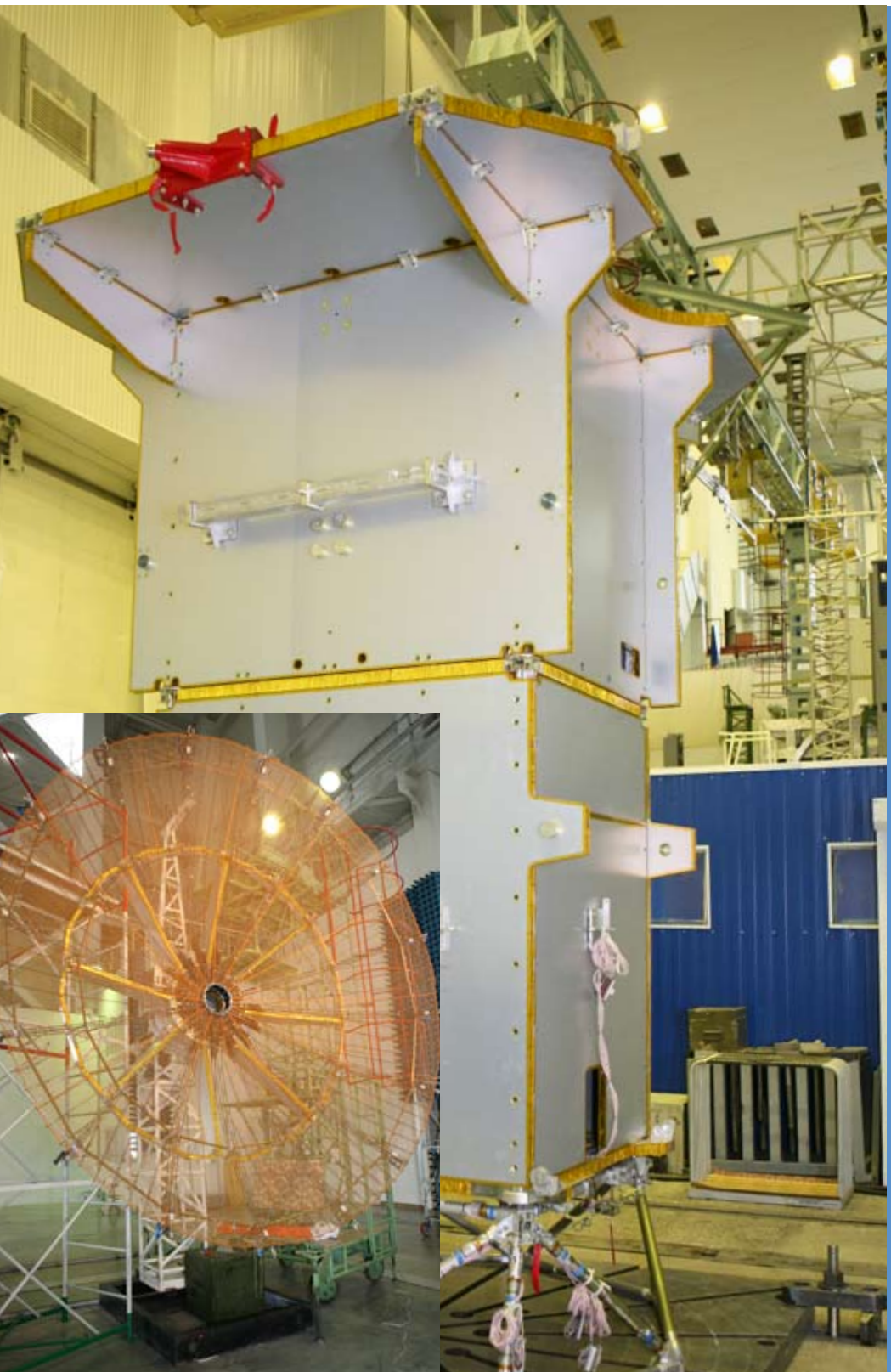
tation and procuring electronic components. 'I am grateful to all the partners for their cooperation in lending effective support and background technical solutions that allowed us to conclude this international contract', addressed Nikolai Testoedov the Council members.

During the meeting the participants determined prospective directions of development for the cooperating enterprises. As Nikolai Testoedov says, today we are meeting targets that were set at the Council meetings of Chief Designers two or even three years ago. For instance, at present the subcontractors make equipment and devices to be used in unpressurized spacecraft and create systems for satellites with a fifteen-year service life. 'Thus, ideas which were discussed at the previous Council meetings of Chief Designers are now being put into life', emphasized the ISS's leader.

The meeting ended with a press conference organized for regional mass media representatives. At the press-conference Nikolai Testoedov summarized the results of the meeting. Responding to the journalists' questions Nikolai Testoedov remarked that the decisions made during the October visiting session of the Russian Federation Government held at the ISS were being implemented in accordance with the plan. In particular, at present adjustments are being made to the Federal Target Program and the Federal Space Program for 2009; the latter is being also updated with regard to 2010 and 2011. Other important decisions put into effect are the on-going restructuring of ROSCOSMOS and the establishment of a number of integrated structures based on the leading space enterprises.

Speaking of the impact of the global economic crisis on the company's financial standing Nikolai Testoedov underlined that despite extra expenses caused by an increase in the cost of credit resources attracted by the ISS to advance its contractors, the company's financial situation was under control. Moreover, the volume of production is expected to increase by 40% in 2009, in comparison with the previous year. 'Not a single employee will be dismissed; there will be no part-time working week', stated the general director. In fact, there has been a salary increase since January 1, 2009. The next salary rise exceeding the rate of inflation is scheduled on July 1, 2009. It will enable the company to maintain a decent standard of living for the employees regardless of inflation.

NEXT-GENERATION relay satellites



In accordance with the Federal Space Program the JSC "Academician M.F. Reshetnev "Information Satellite Systems" is proceeding with work on the creation of the multifunctional space relay system (MSRS), Loutch.

With the launch of up-to-date relay satellites Russia will gain informational independence in terms of ensuring communication with low-earth-orbit objects such as launchers and boosters, unmanned and manned spacecraft and the Russian segment of the International Space Station. In February 2009, the company entered into a State contract that stipulates manufacture of one more Loutch-4 data relay satellite to be used alongside with the Loutch-5A and Loutch-5B satellites that are currently being built for the Loutch MSRS.

Loutch MSRS

For the present moment this is the second contract between the JSC "ISS" and the Federal Space Agency for the establishment of the Loutch multifunctional space relay system. The first contract was made in 2005 and involved a set of operations on the development of two middle-class satellites, Loutch-5A and Loutch-5B based on the advanced Express-1000 platform. However, the plans were later revised, in consequence of which the Federal Space Program was rectified and then approved by the Government of the Russian Federation in 2008. It was decided to introduce a third satellite in the system, the Loutch-4 data relay satellite, with a great technical advantage over the first two satellites. Loutch-4 will be built on the Express -2000 platform developed for heavy-class satellites. The satellite mass will total approximately 3 tons. It will be delivered into orbit by a Proton-M / Breeze-M launch vehicle.

The Loutch-4 satellite will comprise a payload module with the repeater equipment which will have the same functions as Loutch-5A and Loutch-5B, and a number of additional functions. In particular, the satellite will have a satellite-to-satellite Ka-band communication link and an experimental transponder for the mobile personal satellite communications system.

In accordance with the terms of the State contracts, the Loutch-5A spacecraft is scheduled to be launched in December 2010, Loutch-5B is to be injected into orbit in December 2011 and Loutch 4 will be delivered to its designated position in December 2013.

Mission

Data relay satellites are designed for relaying low-altitude spacecraft data. The term "low-altitude" implies all spacecraft operating in orbits at an altitude up to 2000 km. Relay satellites are designed for telemetry and target data receiving, real-time data processing and data transmitting to various receiving points located on the Earth's surface, within the satellite visibility areas. One of the main tasks for relay satellites to perform is to receive and transmit data from/to the International Space Station.

The period within which the Russian segment of the International Space Station is able to communicate with Russian mission control centers is only 2,5 hours per day. During the remaining time our cosmonauts have no communication with the Russian MCC; they are in no communication during space walks either, which is absolutely unacceptable. In case of emergency only a mission control center can make adequate decisions and give appropriate recommendations to the crewmembers.

Today Russia purchases US satellite communication services provided via data relay satellites orbiting over the Atlantic. It costs our country sev-

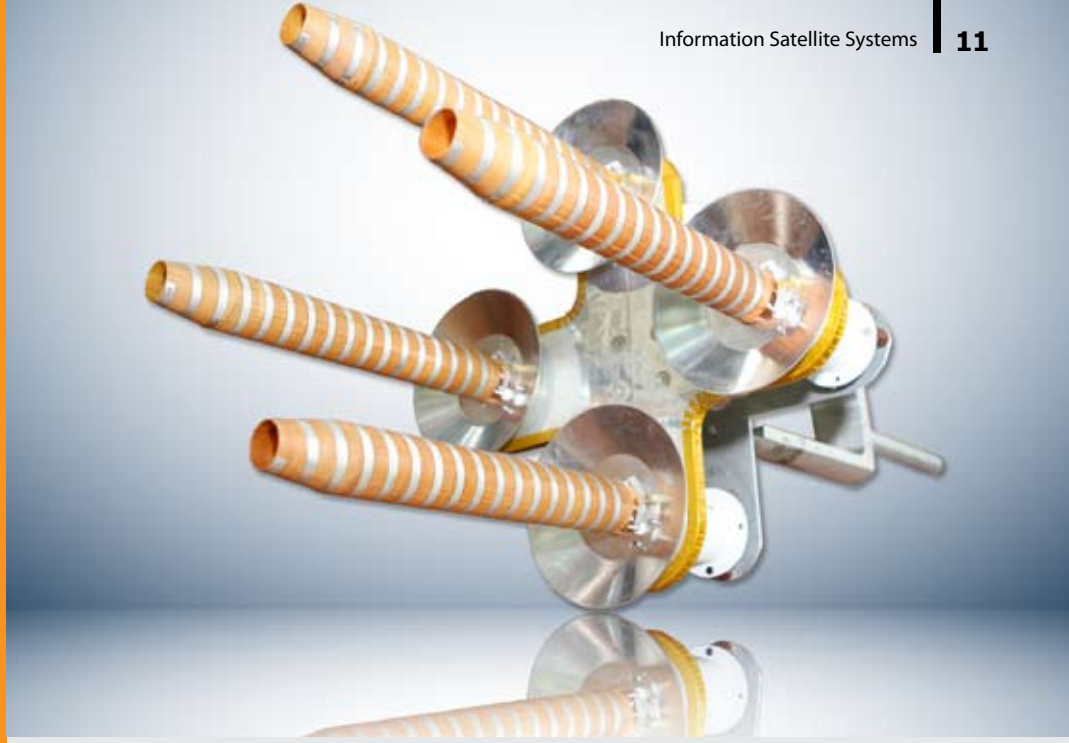
eral million dollars annually. With the launch of its own data relay satellites, Russia will gain complete independence when communicating with the International Space Station and will be also able to provide data relay services for other countries.

What is a third satellite needed for?

In accordance with the Regulations of the International Telecommunications Union, Russia has three orbital positions of satellite location in GSO: at 16°W longitude over the Atlantic, at 95°E over the Indian Ocean and at 167°E over the Pacific Ocean. When three data relay satellites are placed into these orbital positions almost all the Earth's surface except "polar caps" will become visible. Besides, with three relay satellites operating simultaneously in these slots, low-altitude spacecraft will get an opportunity to interact with mission control centers located on the territory of Russia almost all the time.

It was initially planned to place Loutch-5A and Loutch-5B into orbital positions at longitude 16°W over the Atlantic Ocean and at 95°E over the Indian Ocean. However, in 2007 the Presidential Edict was issued to initiate construction of a new launch site, Vostochny, in the Russian Far East. The Vostochny launch site will be located at the site of the former Svobodny launch site. The new launch site is being built for launching carrier rockets of all types including heavy launch vehicles.

The first line of the Vostochny launch site is to be commissioned in 2014-2015. The overwhelming majority of launches will be performed eastwards; consequently, launcher trajectories will run over the Pacific Ocean. Currently, there is no possibility to receive telemetry data from launchers and boosters during this flight phase. Only a relay satellite set at 167°E will enable observation of all launcher routes beginning from the Vostochny launch site, and consequently, it will be possible to receive data from any launcher or any booster at the ascending phase. The possibility of tracking launchers and boosters lifting off from the Vostochny launch site was one of the reasons to introduce a third data relay satellite into the Loutch system.



Siberian Loutches

The ISS was the first to start manufacturing data relay satellites in the late 1970s. The first of them, Loutch, was injected into the geostationary orbit in October 1985 to ensure communications with the Buran space shuttle. Later the Loutch spacecraft provided services for the Mir space station and was also used to perform a number of other missions. In 1995 Loutch-2 was launched into orbit; its mission lasted for three years. The last of the older generation data relay satellites came out of action in 1998. Since then Russia has not had its own spacecraft of this type. New data relay satellites that are being built by the JSC "ISS" will continue the mission of the Loutch satellites. Moreover, new satellites will have a number of additional functions. Unlike Loutch and Loutch-2 which had a three-year lifetime, Loutch-5A and Loutch-5B are expected to operate in orbit for 10 years, whereas Loutch-4 is expected to run for 12 years.

Extension of the Federal Space Program

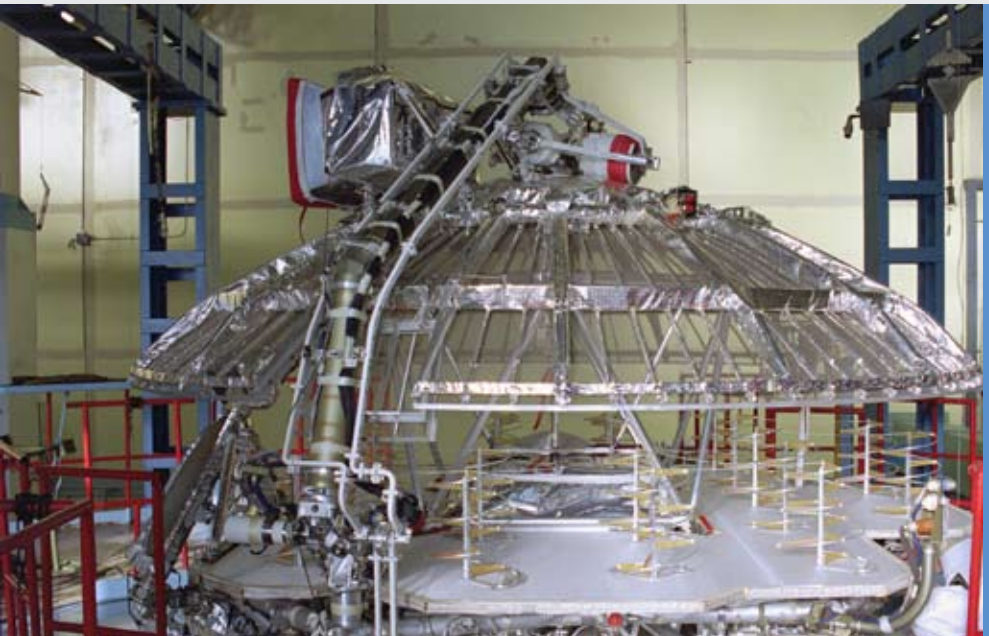
Today, ROSCOSMOS, the federal authority responsible for the formation of all conceptual directions of the Russian space industry development, is entrusted to prepare a draft Federal Space Program covering the period until 2020. The JSC "ISS" prepared a proposal to support and develop the constellation of data relay satellites up to 2020. Loutch-5A and Loutch-5B are expected to be replaced with multifunctional spacecraft. The first in this line is the Loutch-4 data relay satellite. It is worth mentioning that this spacecraft will be performing the same missions as satellites of the US Advanced Tracking Data and Relay Satellite System (ATDRSS).

The ISS provides payload modules

Spacecraft for the Loutch MSRS are being built in time-tested cooperation with other Russian space industry enterprises. Moreover, to implement the project the JSC "ISS" engages foreign partners, in particular the European company, Thales Alenia Space, with its branches located all over Europe, and the Japanese firm, Sumitomo/NEC. Today, these companies are producing component parts of payload modules for the Loutch-5A and Loutch-5B satellites. Sumitomo manufactures low-noise amplifiers and beacon transmitters. Thales Alenia Space supplies power amplifiers and some other on-board repeater equipment items.

In cooperation with the Russian enterprises the JSC "ISS" has elaborated all the required design documentation for the Loutch-5A satellite. At present the satellite and its constituent parts are undergoing ground experimental tests. The flight models of satellite components are scheduled to be completed in the second half of the year, after which they will be arranged for the assembly. The foreign components supplies for the Loutch-5A satellite are due in the second quarter of 2009.

It is important to note, that to manufacture payload modules for Loutch-4, Loutch-5A and Loutch-5B the ISS's specialists are applying a new development scheme. It differs from the previous ones in the fact that for the fist time the ISS has taken full responsibility for the integration, assembly, adjustment and output characteristics of the payload modules for these spacecraft. In addition, our company manufactures a large number of PLM's components, such as the structure, the thermoregulating system, mechanical systems and the antenna&feed system including all feeder circuits and RF elements, as well as the antenna pointing system. All that points to the fact, that the company has considerably increased its share of satellite-building work and has reached a new level of satellite-building technologies.



Sergey Roskin,
MSRS project manager

PROJECTS

New communications satellite

The JSC "ISS" created the Express-AM44 satellite under the contract with the Russian Federal Space Agency, the Ministry of Communications and Russian Satellite Communications Company. In May 2009, on completing the required in-orbit tests, the ISS specialists handed-over the Express-AM44 to the satellite communications operator for the exploitation. Currently, it is the most powerful telecommunications satellite in the Russian satellite constellation.

Cooperation

The satellite was manufactured by the JSC"ISS" in cooperation with Thales Alenia Space. The spacecraft was designed to replenish the national orbital constellation of telecommunications satellites. The JSC "ISS" was in charge of the manufacture of the satellite as a whole, its module of service systems, payload module structure and L-band equipment. The Thales Alenia Space France manufactured and supplied a payload module. The satellite was completed in June 2008, but due to the launch dates shift it was placed in safe storage at the JSC "ISS" premises. The satellite was shipped to the Baikonur launch site in January 2009.

With the launch of the Express-AM44 satellite the JSC "ISS" wrapped up its large program for the manufacture of powerful telecommunications satellites which the ISS had been implementing for eight years. The first satellite of the Express-AM series was launched in 2003. All in all, the company has manufactured and launched seven spacecraft of this type. Today, these satellites provide TV broadcasting and communications services over the territory of Russia and across the border.

EXPRESS-AM44

In-orbit tests

On February 11, 2009 the Express–AM44 telecommunications satellite manufactured by the JSC "Academician M.F. Reshetnev "Information Satellite Systems" was successfully launched by a Proton-M/ Breeze-M launch vehicle in tandem with the Express-MD1 satellite manufactured by M.V. Khrunichev State Research and Production Space Center.

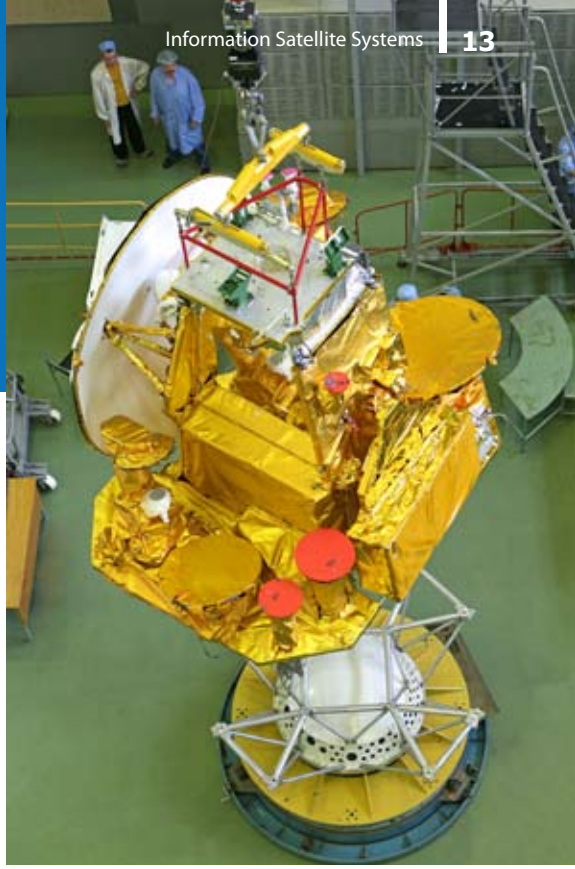
Then, the ISS specialists carried out in-orbit tests of all the Express-AM44's systems. At that time, the telecommunications satellite was controlled by the backup control center located in the Zheleznogorsk Satellite Communications Center under the supervision of the ISS specialists. On April 30, 2009, the in-orbit tests were successfully completed. There were no remarks made regarding the operation of the on-board subsystems. On May 6, 2009, the satellite was handed over to the customer, RSCC; and since then it has been in the nominal use. The Express-AM44's designated orbital position is 11°W.

The Express-AM program

Express-AM44 is the seventh satellite of the Express-AM satellite family. It was created within the framework of the Russian constellation renovation program implemented by the JSC "ISS" in cooperation with Russian and foreign partners during 2001 – 2005. Five satellites of the Express-AM family were manufactured at that time; today they provide communication, TV and radio broadcasting services for the end-users within the territory of Russia and abroad.

The Express-AM44 satellite is equipped with 16 Ku-band, 10 C-band and one L-band transponders. Its lift-off mass is 2532kg; the expected service life is 12 years. The Express-AM44 spacecraft is designed to provide fixed and mobile communications services, digital television and radio broadcasting, multimedia services, data relay services, and mobile presidential and governmental communications.

Orbit	Geostationary
Service life	12 years
Orbital position	11° W
Positioning accuracy for longitude and inclination	±0,05°
Satellite lift-off mass	2534 kg
Payload module mass	575 kg
EPS capacity	6770 W
Payload power supply	4410 W
Communications performances:	
Ku-band	
- number of active channels	16
- frequency band	14/11 GHz
- channel output power	150 W
- channel bandwidth	54 MHz
- minimal EIRP (in areas)	49/53 dBW
- minimal G/T (in areas)	-0,5/+ 6,0 dB/K
- number and diameter of antennas	1 steerable ∅1050mm, 1steerable ∅650 mm
C-band	
- number of active channels	10
- frequency band	6/4 GHz
- channel output power	100 W
- channel bandwidth	40 MHz
- minimal EIRP (in areaa)	36/47,5 dBW
- minimal G/T (in areas)	-10/+3,5 dB/K
- number and diameter of antennas	1 steerable ∅2000mm, 2 global horns
L- band	
- number of active channels	1
- channel output power	85 W
- EIRP (central station - user)	36,5/40,5 dBW
- EIRP (user – central station)	23,0 dBW
- G/T (central station -user)	-3,0/+3,5 dB/K
- G/T (user – central station)	-7,0/-3,0 dB/K
- number of antennas	2 active phased array antennas
Launch vehicles	Launcher Proton-M / booster Breeze –M or DM-type booster



COOPERATION

A SATELLITE SYSTEM for BRAZIL

Strategic partnership relations between Russia and Brazil have been improving in recent years. Today the collaboration policy of these two countries is focused on the exchange of experience and the development of joint projects in the fields of aviation, military industrial complex and nuclear power industry. A special course of action is determined upon so as to develop space cooperation in several ways, the main objective being the collaborative establishment of the Russian-Brazilian telecommunications satellite system. In this project a key part may be assigned to the JSC "ISS", the leading Russian satellite manufacturer.

Within the framework of BRIC cooperation

Brazil's space industry has been developing with the support of China and the USA up to the present moment. Nowadays Brazil is taking its own first steps in the manufacture of communications satellites with the assistance of Russia, one of the world's leading space countries. Brazil is a developing, forward-looking country, which is also the center of South America and the key to the South American telecommunications market. Russia, in its turn, is interested in cooperation with developing countries, in which there is a need for telecommunications services.

Today, the prospects for the Russian-Brazilian space cooperation are subject to the Russian-Brazilian Intergovernmental Agreement on Cooperation in the Exploration and Use of Outer space for Peaceful Purposes. The cooperation between Russia and Brazil is developing within the framework of BRIC political partnership which involves Brazil, Russia, India and China.

It is noteworthy that Russia and Brazil have been cooperating in the manufacture of launch vehicles for quite a long period of time. When in 2003 the Brazilian VLS launcher crashed at the Alcantara launch site, Russian specialists lent all the necessary assistance and set forward a number of proposals so as to avert similar accidents in the future. Besides, the Russian Federal Space Agency offered some technical and organizational solutions, which enabled the Brazilian partners to reconstruct their launch site and to start making VLS-1 and VLS-Alfa launch vehicles through the assistance of Russian enterprises.

Not long ago a new direction in the Russian-Brazilian cooperation took shape in the sphere of unmanned cosmonautics. When Dmitry Medvedev, the President of the Russian Federation, made an official visit to South America on November 26, 2009, a program on cooperation in the use and development of the Russian Global Navigation Satellite System (GLONASS) was signed.

«…The presidents of Russia and Brazil confirmed the priority of cooperation in the Exploration and Use of Outer space for Peaceful Purposes and declared their determination to develop collaboration in this critical sector…. They also expressed satisfaction with the results of the negotiations concerning telecommunications, satellite navigation and training…. The presidents regarded the Agreement on Mutual Technology Control coming into force in connection with the cooperation in the Exploration and Use of Outer space for Peaceful Purposes as an agreement of great importance, which will allow the two countries to proceed to the implementation of the joint projects.

From the Joint Statement of the President of the Russian Federation and the President of the Federative Republic of Brazil made on 26th November, 2008

The JSC "ISS" took part in the seventh international Latin American Aerospace and Defence trade show (LAAD -2009) on 14 -17 April in Rio-de-Janeiro, Brazil.

As part of the integrated exposition of the Russian Federal Space Agency, the JSC "ISS" exhibited a model of the advanced multifunctional satellite platform, Express-4000, designed for geostationary and high elliptical heavy-class spacecraft. LAAD 2009 visitors and guests were also shown models of the next generation Glonass-K navigation spacecraft, the Loutch-5A data relay satellite and the Amos-5 telecommunications spacecraft that is being built at the "ISS" for SPACE-COMMUNICATION LTD, the Israeli satellite communication service provider.

Activities of the working group

Directions of the Russian-Brazilian cooperation in satellite-building were determined in October, 2008 at the meeting of the Brazilian Space Agency's delegation with the representatives of ROSCOSMOS (the Russian Federal Space Agency). The JSC "ISS" was represented by Victor Lavrov, the ISS's chief designer.

During the October meeting the Brazilian delegation became acquainted with the activities carried out at the JSC "ISS" in the sphere of building multifunctional satellites, including telecommunications spacecraft. In particular, great emphasis was laid upon the company's progress in cooperation with foreign partners and activities on the international space market. The representatives of the Brazilian Space Agency officially announced their intention to create a telecommunications satellite system, consisting of geostationary spacecraft. In their turn, the representatives of the Russian Federal Space Agency set forward a proposal to initiate a joint project based on Russian-Brazilian satellites. In order to carry out the project it was decided to establish a joint working group.

The meeting of the newly-established Russian-Brazilian working group was held in early March, 2009 in the city of Brasilia, Brazil. The main aim of the meeting was to coordinate work of the two agencies in order to carry out the Program on Cooperation in the Establishment of Telecommunications and Meteorological Satellite System in Brazil.

At the meeting the JSC "Information Satellite Systems" presented preliminary specifications of the advanced Brazilian geostationary satellite system. The ISS's specialists proposed two options for Brazil's orbital constellation. The first one included middle-class satellites based on the Express-1000 platform, whereas the second option involved heavy-class spacecraft based on the Express-2000 platform.

During the March meeting the representatives of ROSCOCMOC and the Brazilian Space Agency exchanged their opinions about the directions of the project implementation and drew up an action program for the nearest future.

Prospects

It must be emphasized that the project on establishing the Brazilian telecommunications satellite system will be implemented jointly with Brazil, as the system requires setting up a ground segment, which is hard to perform without the participation of the Brazilian party.

The cooperation between Russia and Brazil in the sphere of satellite-building will definitely contribute to the development of the Brazilian space industry. At present Brazil's experimental satellite production and training facilities are underdeveloped. Consequently the JSC "ISS" offered assistance in providing both training for Brazilian specialists at all project stages and technical support during the operation stage. Besides, joint efforts will enable the Brazilian partners to adopt sound experience of our specialists.

With the possibility for the JSC "ISS" to participate in the project, the company might get loaded up with work for a long period of time, as the Brazilian satellite system will require a minimum of two to three satellites. It is worth mentioning that cooperation with Brazil will open some definite prospects for Russia. At present Brazilians are constructing the Alcantara launch site, situated near the Equator, which is an excellent launch area due to its geographical position for injecting geostationary satellites into orbit. In the future Russia might also consider an opportunity of using the Brazilian launch site.

The project development

According to the representatives of the Brazilian Space Agency, at the present time they are trying to get finance for the joint project. Besides, now all the statements of the Brazilian Ministries on the needs, types and volume of satellite communications services are being summarized. This summary is to be submitted to the JSC "Information Satellite Systems" in May 2009 and on its basis the ISS's specialists will proceed to the detailed development of the project, system specifications, including requirements for the ground segment. The JSC "ISS" will also render the Brazilian Space Agency technical support when generalizing preliminary research data on the project concept and the possibility of establishing the system.

Within the framework of the project implementation the JSC "ISS" is to prepare a system feasibility analysis to meet the requirements of the Brazilian party. In addition, the material to be submitted should include possible technical solutions to the way how telecommunications and meteorological payloads can be combined in one satellite. The need for additional meteorological functions in the satellite is determined by the demand of the Brazilian party to observe weather as their climatic conditions over the Brazilian coast are rather changeable and often cause natural catastrophes. The proposals prepared by the JSC "Information Satellite Systems" will be discussed at the meeting of the joint working group to be held in June, 2009 at the JSC "ISS." Besides, as part of the visit, the representatives of the Brazilian Space Agency will get an opportunity to get acquainted with the ISS's production facilities.

Victor Lavrov,
chief designer.

FUTURE ENGINEERING ELITE OF THE RESHETNEV COMPANY

The complete cycle of spacecraft production requires that the JSC "ISS" should have a broad range of specialists.

The JSC "Academician M.F. Reshetnev "Information Satellite Systems" is one of the leading enterprises in the Russian space industry. Its personnel policy is moving in the direction of providing target training for young specialists to help them acquire professions mostly demanded by the industry, as well as to make their social integration easier and to contribute to their further professional development. Within the framework of the youth program the ISS takes a direct part in vocational preparation of students, applying innovative training techniques.

The complete cycle of spacecraft production requires that the JSC "ISS" should have a broad range of specialists. Traditionally the company sought for the best candidates in higher educational institutions of the European part of the country, such as Moscow Aviation Institute, M.E.Bauman Moscow State University, D.F.Ustinov Baltic State Technical University, Kazan Aviation Institute, Kuibyshev Aviation Institute and others. In the 1960s graduates of these higher educational establishments formed the basis of the company's future engineering elite. Furthermore, at the beginning of the ISS's history close links were established with some Siberian technical universities.

Today, due to the geographical remoteness of the JSC "ISS" from the Russian Federal Center, great emphasis is laid on training students in Siberian technical universities, such as Siberian Federal University, Siberian State Aerospace University, Tomsk Technical University, Tomsk Polytechnic University and Tomsk State University of Control Systems and Radioelectronics. In addition, since 2007 a great deal of effort has gone into the reestablishment of close links with D.F.Ustinov Baltic State Technical University, Moscow Aviation Institute, M.E. Bauman Moscow State University and A.N. Tupolev Kazan State Technical University.

The specific character of the closed city of Zheleznogorsk, in which there are two science-intensive city-forming enterprises, the JSC "Academician M.F. Reshetnev "Information Satellite Systems" and the federal state unitary enterprise, the Mining and Chemical Combine, stimulates school leavers to enter technical universities. A number of Zheleznogorsk schools specialize in physics and mathematics. Besides, in the city there is a regional center for gifted children, called Cosmonautics School. All these factors, in combination with the ISS's multilevel carrier guidance activities, enable the enterprise to make target intakes of students by selecting candidates from the city's best school leavers.

In accordance with the Order of the Ministry of Education and Science the JSC "ISS" has been taking part in the target training of young specialists since 2008 within the framework of the State Program for the preparation of scientists, specialists and workers for the Defence industry.

To realize the crucial personnel policy on attracting, hiring, integrating and training young specialists the JSC "ISS" has worked out a program which is constantly improved so as to achieve its goals in personnel management. The program covers stages from students' training to their career planning.

Special attention is paid to cooperation with higher professional educational establishments so as to increase the effectiveness and quality of the preparation of future specialists. The cooperation with higher institutions is developing in a number of ways:

- All types of practical work and graduation ceremonies are organized in the ISS's various departments.
- Specialized training is provided at the enterprise by basic sub-faculties and their branches.
- Students get involved in scientific research and experimental development activities conducted jointly with higher educational establishments.
- Assistance is given in the equipment of laboratories and classrooms.
- Collaborative effort goes into the elaboration of professional educational standards.
- Innovative project-oriented training techniques are applied to teach students.

One of the examples of the project-oriented approach is the application of the integrated training system at M.F. Reshetnev Siberian State Aerospace University, aimed to provide students with continuous learning guidance from the moment they enter university till they get employed by the JSC "ISS". Various sub-faculties are involved in the training process, for instance, the sub-faculties of space vehicles, control systems, mechanical engineering, electronic engineering and some others. Some of them are located at the ISS's premises. Therefore, when doing practical work in the company's various departments students also take a direct part in the production process.

It is expedient to apply this scheme of preparing students in combination with the project-oriented training, coordination and control of the educational process. With this aim, the JSC "ISS" jointly with Siberian State Aerospace University (SIBSAU) have established a scientific and educational center (SEC) "Space Systems and Technologies". Project teams are composed of students of different professions including humanitarian ones. The need for a particular specialist is determined by a set of project tasks to be accomplished.

The creation of a small-sized spacecraft is the ISS's on-going educational project. It allows the company to clearly formulate competence requirements for young specialists to meet when working on a satellite-building project. The advantage of the Small-class Spacecraft Building project (SSB) is that it enables students to get acquainted with the satellite-building process. Besides, small-class satellites are high-tech objects, and so while studying at university students go through different stages, from concept development to concept realization in a concrete model.

In accordance with the suggested approach the SEC has picked out ten main directions of the SSB project and formed a team of ISS's specialists and SIBSAU's scientists who define a range of scientific and technical problems for each direction. A students' team is composed of third, fourth, fifth and sixth-year students of different specialities. Third and fourth-year students study the program they choose under the leadership of SIBSAU's scientists. When in their fifth year, students do practical work at the JSC "ISS" under the guidance of the ISS's specialists.

To participate in the SSB project students get selected in their third year of studies; an individual syllabus is tailored to every single student. An individual study plan is formed on the basis of the company's requirements for students' competences. During the educational process the employer controls the quality of the preparation of students and thus is able to affect and correct the process.

The organization of the SSB project management is based on the Internet distributed project management system (http://smka.sibsau.ru) which agrees with the 2004 Project Management Institute standards.

The individualization of the training process is the key feature of the

PROFESSIONALS

The first results of the applied project-oriented technology were the creation of a small-class spacecraft named Yubileiny in 2007 which is now successfully operating in orbit, and the establishment of a small-class spacecraft control center at SIBSAU.

preparation of specialists in the context of the project-oriented approach. It enables the students to gain knowledge needed for their careers and at the same time to apply it at a concrete enterprise. So, there are both educational and experience opportunities. In addition, a future specialist learns how to make decisions and to be critical of his own work. On having gained scientific and practical experience, a graduate student is able to better understand the employer's requirements, to adjust quickly to the production process, to make useful professional contacts and to direct his own learning and development.

This method is attractive for students as it provides them with authentic learning experience and motivates them to gain new knowledge so as to be able to work in high-tech fields.

Within the framework of SSB the project the SIBSAU's students have already accomplished the following tasks:

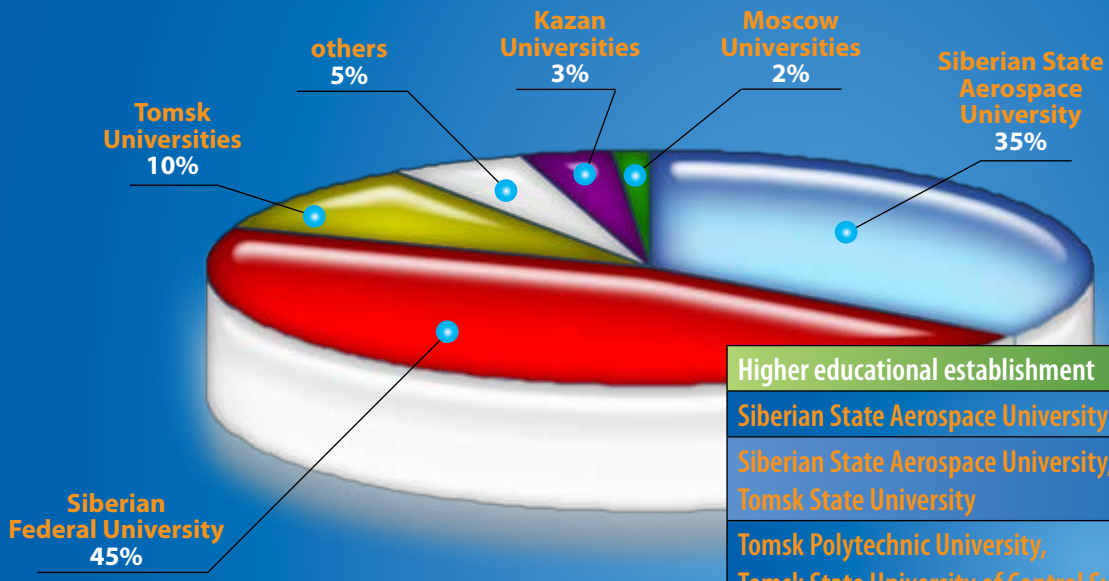
- They have designed and installed a RADEC apparatus on board the spacecraft to carry out research and scientific experiments to test the efficiency of protective coatings;
- They have performed the integration of the RADEC apparatus with the payload module;
- They have taken part in the calculation of RADEC's temperature conditions, the required power for the satellite's electric power supply system, the energy consumption of the equipment and the solar array surface area. The students have also taken a direct part in the design of the satellite components, such as a fixation bracket.

The first results of the applied project-oriented technology were the creation of a small-class spacecraft named Yubileiny in 2007 which is now successfully operating in orbit, and the establishment of a small-class spacecraft control center at SIBSAU.

This method of preparing students for work at the ISS implies a larger number of project participants. As the project-oriented approach is realized via the Internet, there is a possibility for students and lecturers of other Russian universities to take part in the SSB project. At present a number of universities are considering the possibility of participating in the creation of a new small-class spacecraft. These are Siberian State University, Moscow Aviation Institute, M.E.Bauman Moscow State University, Tomsk State University of Control Systems and Radioelectronics and D.F.Ustinov Baltic State Technical University.

Nikolai Testoedov, the ISS general designer and general director.

Sergei Kukushkin, the ISS deputy general director of HR department.



Higher educational establishment	Number of ISS employees
Siberian State Aerospace University	1107
Siberian State Aerospace University, Tomsk State University	1332
Tomsk Polytechnic University, Tomsk State University of Control Systems and Radioelectronics	284
Kazan Universities	93
Moscow Universities	44
others	142

TECHNOLOGY

THE ISS'S UNIQUE FACILITY

The JSC "Academician M.F. Reshetnev "Information Satellite Systems" is proceeding with the construction of the new building for assembling and testing antennas and antenna&feed systems. The building, unique in its design and technological equipment, will definitely open up new production possibilities for the JSC "ISS".

The new facility is designed as a large laboratory with a special microclimate necessary for assembling and testing antennas and antenna&feed systems, as well as for performing other productive operations. Inside the building there is nothing superfluous. Utilities and amenities are excluded from the facility. Besides, the power supply and air conditioning of the workshop is centered in outside power generating units. The equipment installed in the power-generating units and two-stage air cleaners are intended to create parameters of air purity, humidity and temperature inside the building, which is required for the antennas production. To prevent the clean rooms from contamination, the facility employs air locks.

One of the unique technological features of the new building will be the capability of testing mechanical structures in weightlessness. To achieve this, specialists from the ISS Design Bureau are developing a universal zero-gravity system which will allow testing antenna reflectors and solar arrays of different dimensions and mass.

The selected design of the facility enabled the company to save a significant amount of finance. For instance, to build a metal skeleton twice as little metal was used as it could have been used to erect a concrete-steel building of the same size. Besides, the dome-shaped roof does not require a lot of maintenance and clean-up costs, and it is easy to maintain.

It is important to note, that all redundant internal construction elements, which could interfere with the full-scale production of large structures, are excluded from the facility. When needed, specialists can install any equipment or accessories. Thus, the facility is expected to be multifunctional and universal. It is designed not only to carry out the antennas production but also to allow the company to put new technical ideas into life in the nearest decades.

At present another construction phase is over, with the metal skeleton of the building completely erected. The building represents a dome consisting of 32 ribbed arches forming a circle with a diameter of 72 m and supported by metal columns. At present the basement, entrance airlocks and power-generating units are being constructed. Up-to-day facing and roofing materials have been procured.

According to the specialists of the ISS's Capital Construction and Capital Repairs Department, the construction work is progressing on schedule. The facility is to be prepared for the equipment installation in the third quarter of 2010. It is planned to put the facility in operation phase-by-phase. The assembly of large mechanical systems is scheduled for 2010.

0-G SYSTEM FOR LARGE REFLECTORS

During the ground tests of foldable large-scale antennas or during ground tests and checks of the appropriate control system, one of the most important conditions to do that is to ensure weightlessness of structures (i.e. compensation of mass) with the aim of preventing the structure deformation or destruction caused by the Earth gravity attraction.

Large reflectors for the space application have been manufactured both in our country and abroad since 1980s. However, their wide use for the production of space telecommunications systems starts only nowadays. The JSC «Information Satellite Systems» as the major Russian manufacturer of satellite systems is intensively developing this field of activities involving significant scientific, production and financing resources.

Increased dimensions of satellite antennas allow improving their coefficient of utilization. The most effective are large-scale antennas ensuring mobile communications services. A number of experiments have been carried out on several different satellites recently to check antenna structure deployment. The analysis of foldable large-scale reflectors available at the international market has shown that despite some progress achieved in this field of activities, just a few models are capable of keeping the specified shape and required stiffness of the structure. Besides, the reflector deployment is not 100% reliable. This is due to violation of the employed technologies at the stages of production of the structure parts and sub-assemblies, taking into account life characteristics and highly precise assembly at the assembly benches; or during antenna tests at the test benches.

During the ground tests of foldable large-scale antennas or during ground tests and checks of the appropriate control system, one of the most important conditions to do that is to ensure weightlessness of structures (i.e. compensation of mass) with the aim of preventing the structure deformation or destruction caused by the Earth gravity attraction.

Within the JSC “ISS” organization, the specialists of the Satellite production accessory design department were responsible to ensure the weightlessness of large-scale antennas during ground tests. Besides, it was important to provide maximum control of the antenna

weightlessness process. The preliminary analysis showed that there were no analogue systems in the world. Within the shortest possible period of time the specialists carried out a lot of preparatory activities in terms of selecting a controlling system, actuators and monitoring elements to be purchased from the foreign suppliers. The monitoring system was gambled on using microcontrollers, intelligent electric drives and a set of specified sensors, which allowed ensuring full control and monitoring of the weightlessness process through a personal computer. Following the documentation developed by the Ground support equipment and instrumentation workshop, the system mechanisms were manufactured, and a portion of EQM system was assembled and tested thus demonstrating that the monitoring system fully met the appropriate requirements.

Then, the decision was made to use the system to "weightless" large-scale antennas designed and manufactured by the ISS.

The system operation principle is as follows: the controlling unit comprising a microcontroller and a personal computer with necessary software programs embedded generates an operation algorithm for the monitoring system. In the motion checkpoints of the structural elements the component mass values are recorded, and depending on these values the program sends a command to intellectual electric drives which sustain the structure in the weightless position.

FOR THE TIME BEING, the system developed by the ISS specialists is unique and does not have any analogue in the world. It has been patented.

The system allowed simplifying the design of the 0-g device which simulates weightlessness conditions. Moreover, an operator obtains a possibility to monitor in the screen the process progress and any changes to the component mass of the weightlessed structure in any point of its trajectory. The system is able to keep a single element or a structure in weightlessness under various motion rates.

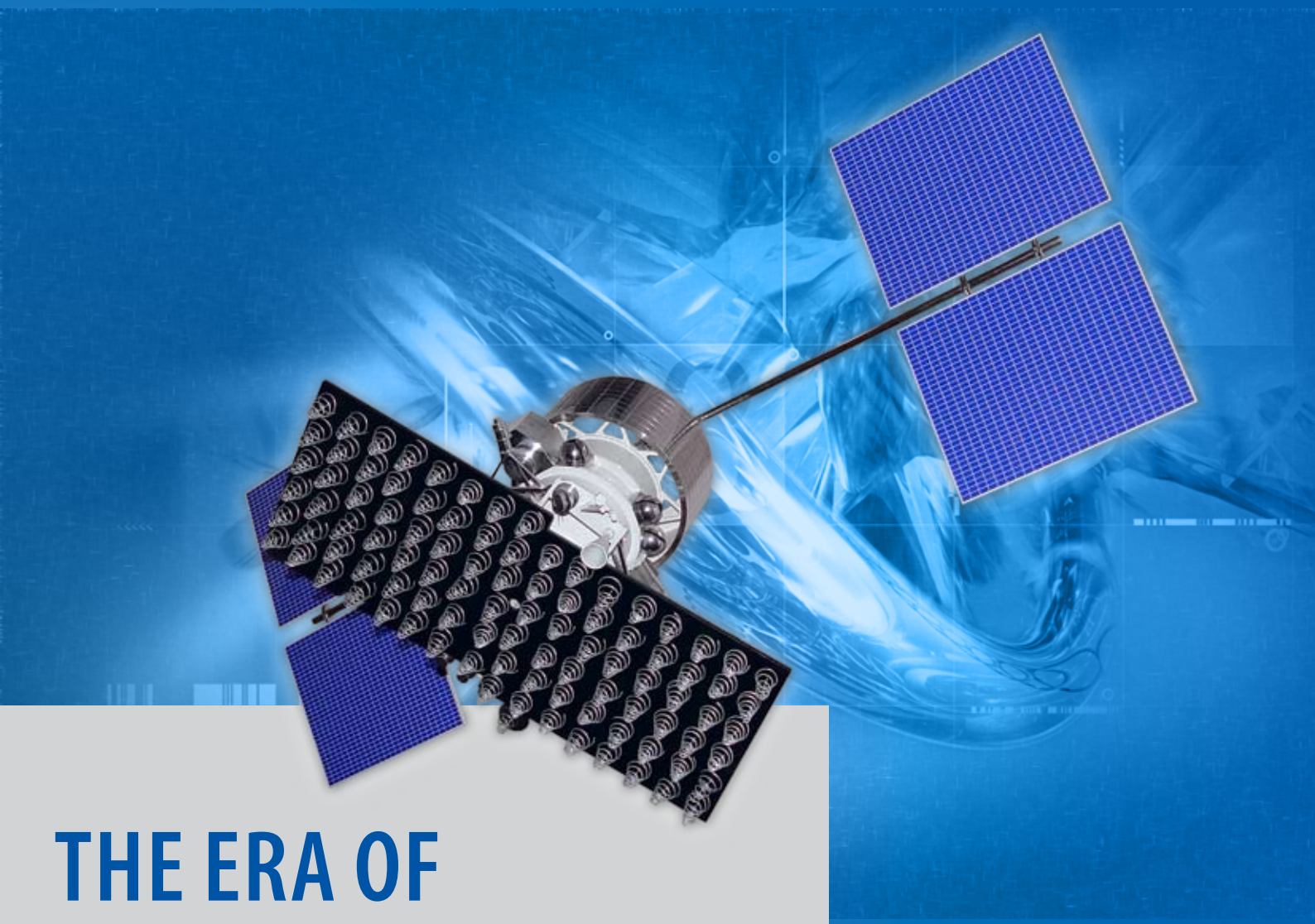
The control of the weightlessness process is completely automated and is ensured by an operator. The controlling program has a standard interface and allows both automatic and manual control modes. The program is designed so that to exclude any contingency situations when an antenna is being deployed. Today, the system is fully operable and is used as a part of foldable large reflector assembly working area. Its main purpose is to check reflector deployment with the aim of verifying the assembly quality, position stability of primary spokes and surface geometric parameters, as well as to verify the operability of all antenna mechanisms. The application fields of the system are gradually increased. For example, now it is used for antenna assembly operations and stiffness tests. One of important advantages is that the system constituent parts are capable of individual arranging and tailoring for each primary spoke of an antenna. The mass of the spoke itself, shape-generating structure and mesh are accounted for.

For the time being, the system developed by the ISS specialists is unique and does not have any analogue in the world. It has been patented.

The progress is going on and having in mind the tendency for further enlargement of reflector dimensions, the department specialists have made new design solutions to be implemented in advanced achievements of our company. The appropriate requests for certificates of recognition have been already made.

Aleksey Drozdov, designing engineer of Satellite production accessory design department

HISTORY



THE ERA OF THE EKRAN SATELLITES

Direct TV broadcasting systems based on the Ekran satellites developed by the ISS specialists (1976 – 2001) were in use for more than 30 years.

In February 2009 the federal state unitary enterprise 'Russian Satellite Communications Company' made a decision to stop broadcasting the Orbita-3 television program via the Ekran-18 satellite, the last direct TV broadcasting satellite. Thus, the 32-year system ceased to exist.

The system was established in the 1970s with the aim of providing TV broadcasting services for hard-to-reach cities, towns and villages of the Far North, Siberia and the Russian Far East.

At that time the creation of the direct TV broadcasting system was a priority task of the national space industry, which was controlled by the Soviet Government. The Applied Mechanics Design Bureau (now the JSC "Academician M.F. Reshetnev "Information Satellite Systems") was entrusted to develop and manufacture a direct TV broadcasting satellite. The repeater equipment and the ground control segment were developed by the Moscow Research Institute, NII RADIO. Great responsibility for the net result devolved on the contractors.

The first Ekran satellite was launched into the geostationary orbit on October 26, 1976. The satellite's guaranteed service life was one year. The launch of the satellite heralded the establishment of the space system intended to broadcast Central Television programs to small receiving stations, located in the Far North, Siberia and the Russian Far East.

The transmitting antenna of the satellite was pointed in such a way that television signals from the satellite could be received far beyond the Arctic Circle, despite the fact that the satellite itself was located in the equatorial plane. The use of the direct TV broadcasting system was not restricted to the above-mentioned regions. The on-board antenna pointing system also allowed receiving TV signals in the territory of Mongolia, South-East Asia and even in Australia, in the side lobe pattern.

In our country transmit-receive television stations were set up almost anywhere within the satellite service area: in industrial forestry areas, in small towns, on deer farms and also aboard ships plying the Northern Sea Route. By the time the first satellite was launched, 60 transmit-receive television stations had been already set up. Inhabitants of the country's remote regions got a chance of watching Central Television programs of good quality. The previously used TV broadcasting satellite system "Orbita" required setting up awkward ground control systems and was only able to provide television

HISTORY

broadcasting services for large cities and their suburbs within a radius of 40 to 50 km. The direct TV broadcasting system employed relatively inexpensive and small-size transmit-receive stations for individual and shared use. Individual stations could provide cable television only for one to several houses, whereas community television stations – for one to several settlements located in the line-of-sight coverage of a transmit-receive station. The pointing of ground station antennas was easy to perform; it could be done with the help of an ordinary theodolite.

Rave reviews of the system operation circulated everywhere – in the papers and among the population.

On December 1, 1976 the Pravda newspaper published an article by M.F. Reshetnev entitled "Spacebridge works", in which he wrote: "...the creation of the Ekran satellite is a new step in applied cosmonautics". The article appeared under the pseudonyms of M.Fedorov, G. Markelov.

For the first time ever Taimyr, Dickson and Chukotka got a chance of watching Central Television programs. When the national press journalists arrived there they were very much impressed by the good quality of television programs.

Nevertheless, in the history of the direct broadcasting system there were difficult periods. In 1977, the second Ekran was launched. With its launch the duration period of a television broadcast reached 18 hours per day. However, it orbited only for a year.

The next three launches were unsuccessful. Therefore, the whole broadcasting load was laid on the first spacecraft. The duration of a broadcast reduced to 1-2 hours per day.

The problem of the unsteady operation of the direct broadcasting system was taken under strict control by the propaganda department of the Central Committee of the Communist Party.

Meanwhile specialists of the Applied Mechanics Design Bureau, who provided the satellite in-orbit operation, spent months away from home travelling on business trips.

The sixth and seventh satellites were launched at an interval of eight months in 1979. Thus, the problem of broadcasting TV programs via the Ekran satellites got solved.

In 1980-1983 the minimum interval between satellite launches was five months.

In 1983 it was decided to install additional solar arrays so as to eliminate the energy performance problem and to provide twenty-four-hour telecasting. As a result, by means of just one satellite it became possible to provide continuous day-and night television broadcasting.

However, those improvements did not solve the problem of the unsteady system operation completely. So, the Applied Mechanics Design Bureau started work on a modernized version, Ekran-M, which was intended to provide continuous day-and-night direct television broadcasting. The service life of modernized satellites was increased to three years.

The first Ekran-M satellite was launched on January 30, 1987, though unsuccessfully.

Continuous direct television broadcasting became available only with the launch of a second spacecraft, on December 12, 1988. However, telecasting broke off in 2001 when the fifth Ekran-M satellite suddenly stopped its in-orbit operation. By that time another three satellites (the sixth, seventh and eighth) had been manufactured and tested, and laid in stock. Then, by V. Putin's direct order, the eighth satellite, Ekran-M #18, was urgently prepared and launched on April 7, 2001. It served till February 9, 2009.

Fundamentally new technical solutions introduced and applied in the Ekran and Ekran-M satellites, were later used to develop Gorizont, Raduga-1, Potok and many other spacecraft of the ISS's manufacture. Those solutions concerned the linear attitude control, solid-state transponders, electric power supply system providing continuous, day-an-night operation of repeaters and many others.

Years spent on the development and use of the direct television broadcasting system, which involved Ekran and Ekran-M satellites, marked a new epoch in the history of the enterprise, as well as in the history of Russia's applied cosmonautics.

Vladimir Lapushkin, head of section for automated control systems design and orbital constellation operation.

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GLONASS-M

GLONASS-K

GLONASS

GLONASS

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