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Committee on the Peaceful Uses of Outer Space

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

Addendum

II. Replies received from Member States

Russian Federation

[Original: Russian]

[13 December 2010]

1. Introduction

The national activities of the Russian Federation in 2010 in the use of outer space for peaceful purposes were carried out by the Russian Federal Space Agency (Roskosmos) under the Russian Federal Space Programme, the Global Navigation Satellite System (GLONASS) special federal programme and other special programmes, in cooperation with the Russian Academy of Sciences, the Ministry of Defence of the Russian Federation and other clients and users of space information and services.

As at 1 October 2010, the Russian Federation had carried out 23 carrier rocket launches. A total of 30 space objects (20 Russian and 10 belonging to other countries) were launched.

The following Russian space objects were launched:

(a) 2 manned Soyuz TMA spacecraft (Soyuz TMA-18 and Soyuz TMA-19);

(b) 4 unmanned Progress-M cargo vehicles (Progress M-04M, M-05M, M-06M and M-07M);

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(c) 1 communications satellite (Gonets-M);

(d) 1 Tekos experimental satellite;

(e) 6 GLONASS-M satellites;

(f) 1 Globus-1 communications satellite;

(g) 5 Cosmos satellites (Cosmos-2462, Cosmos-2463, Cosmos-2467, Cosmos-2468 and Cosmos-24xx).

The following space objects were launched on behalf of foreign clients: Intelsat 16, EchoStar 14 (United States of America), CryoSat-2 (European Space Agency (ESA)), AMC-4R (SES-1) (United States), SERVIS-2 (Japan), Arabsat 4B, Prisma (Switzerland), Picard (France), TanDEM (Germany) and EchoStar 15 (United States).

A total of 20 space objects were launched by 16 carrier rockets from the Baikonur launch site. Seven space objects were launched by five carrier rockets from the Plesetsk launch site. Three space objects were launched in two launches from the launch silo at the Dombarovsky launch base (Orenburg region). A Russian module of the International Space Station (ISS) (Mini-Research Module 1 — Rassvet ("Dawn")) was launched aboard United States space shuttle Atlantis STS-132, a reusable space transportation system, in May 2010.

2. Main results

(a) Manned flight programme

In 2010, the Russian Federation, in accordance with its international obligations regarding the development and operation of ISS, launched two manned Soyuz TMA spacecraft and four unmanned Progress-M cargo spacecraft, controlled and tracked the flight of the Russian segment of ISS and implemented a planned programme of research and experiments.

(b) Programmes on space technology applications

Space communications, television transmission and navigation

The orbital network for space communications, television transmission and navigation includes the following space objects: Ekspress-A, Ekspress-AM, Ekspress-MD1, Yamal-100, Yamal-200 (communications, television), Ekran-M, Bonum-1 (television channel NTV), Gonets-D1, Gonets-M (communications), GLONASS and GLONASS-M. In 2010, work continued within the framework of the GLONASS special federal programme to support, develop and use the GLONASS system, including the construction of new-generation satellites with improved performance characteristics. As at 1 October, there were 21 GLONASS satellites in the orbital network, on three orbital planes. The system provides coverage of 98 per cent in the Russian Federation and 87 per cent globally.

It is expected that by the end of 2010, no fewer than 24 satellites will be operating on a continual basis in the GLONASS network and test flights of the new-generation GLONASS-K satellite with additional new navigation signals will begin.

Within the framework of the activities of the International Committee on Global Navigation Satellite Systems, established at the initiative of the United

Nations, and of cooperation with experts from other countries, work is being undertaken to define the principles governing the compatibility and complementarity of all existing and emerging satellite navigation systems. The results of this work are being taken into account in determining how best to modernize GLONASS in order to ensure global access for all users.

Remote sensing of the Earth, meteorological observations, environmental monitoring and natural disaster management

In the Russian Federation, hydrometeorological and natural-resource satellites are used in environmental monitoring, research and socio-economic applications. The Russian Federation's two-tier hydrometeorological system for remote sensing of the Earth involves the use of Meteor and Elektro hydrometeorological satellites.

Currently, the satellites Resurs-DK1, Monitor-E and Meteor-M1 are in orbit. Work is nearing completion on the development of new-generation hydrometeorological satellites (Elektro-L1 geostationary satellites).

The Resurs-DK1 satellite obtains remote sensing data for the purposes of:

(a) Creating records of land resources;

(b) Thematic mapping of land;

(c) Monitoring of emergency situations and assessment of their consequences;

(d) Geological mapping and mineral exploration;

(e) Monitoring and control of the state of forests and agricultural crops and harvest forecasts;

(f) Monitoring and control of land development and irrigation;

(g) Monitoring and control of ice and snow cover over inland water bodies;

(h) Environmental monitoring.

In order to achieve the most comprehensive possible monitoring of the environment, work is under way to establish and build up a system of specially designed space facilities for that purpose within the framework of the Federal Space Programme (FKP-2015). The following will shortly become operational:

(a) Geostationary meteorological satellites (Elektro-L) for the observation of large-scale processes in the atmosphere and on the Earth's surface in the tropics;

(b) Polar-orbiting meteorological satellites (Meteor-M) at relatively low altitudes (800-1,000 km) for the global integrated observation of the atmosphere and the Earth's surface;

(c) Real-time optico-electronic observation satellites (Resurs-P and Resurs-PM);

(d) Satellites for oceanographic monitoring (Meteor-M3);

(e) Observation satellites using high-precision radiolocation for all-weather surveying of the Earth (Arkon-2M);

(f) Satellites for the monitoring of disasters and the investigation of potential earthquake precursors (Kanopus-V);

(g) High-precision observation satellites for cartographic purposes.

Work is in progress to set up the multi-purpose space system Arktika, which will include radiolocation observation satellites and hydrometeorological satellites for observation of the Arctic region.

In 2010, work continued on developing the main Earth remote sensing information centre. New stations for receiving, processing and storing data are being set up, and a data collection system for Eurasia has been launched.

Natural disaster management using space technology

One of the priority areas of the space activities of the Russian Federation involving Earth remote sensing is the development of space technologies and information support for natural disaster management, including:

(a) The forecasting, continuous and near-continuous monitoring, detection and tracking of hazardous phenomena in the atmosphere and at sea (such as hurricanes, gales, typhoons and ice formations) using data obtained in various regions of the optical and radio (ultra-high-frequency) ranges of the electromagnetic wave spectrum from Meteor and Elektro satellites;

(b) The monitoring, detection and tracking of floods using data from Meteor and Resurs-DK1 satellites (new space technologies for the provision of information to facilitate natural disaster management are to be developed and applied);

(c) The detection and tracking of forest fires that cover an area of more than 40 hectares, using the smoke plume and data from Meteor-M and Resurs-DK1 satellites obtained in the visible and infrared ranges of the electromagnetic wave spectrum.

(c) Space research programmes

During 2010, the Russian space sector participated successfully in foreign projects in the area of basic space research. The main results of space research were obtained during observation programmes conducted on board the International Gamma-Ray Astrophysics Laboratory (INTEGRAL) of ESA.

Research continued on cosmic rays and corpuscular flows within the framework of the Russian-Italian Mission (RIM) Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics (PAMELA) project. The recorded number of antiprotons and positrons exceeds by an order of magnitude any other figure established by global statistics in that area to date.

In the field of planetology, studies of Mars and Venus were continued using Russian instruments (the Planetary Fourier Spectrometer (PFS), the Ultraviolet and Infrared Atmospheric Spectrometer (SPICAM), OMEGA Visible and Infrared Mineralogical Mapping Spectrometer, Analyser of Space Plasma and Energetic Atoms (ASPERA), High Resolution Stereo Camera (HRSC) and Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) Altimeter) on board the European spacecraft Mars Express and Venus Express. Further research of the planets' surface and atmosphere was carried out, and the data obtained are being processed and analysed.

Work continued on board the American Mars Odyssey spacecraft to detect and locate subsurface aqueous ice on Mars using the High Energy Neutron Detector (HEND) instrument complex, which the Russian Federation helped to develop (HEND makes it possible to register fast neutron flows from the surface of Mars caused by the action of solar winds). It is planned to continue the research during further experiments on board the Lunar Reconnaissance Orbiter of the National Aeronautics and Space Administration (NASA) of the United States, using the Lunar Exploration Neutron Detector (LEND).

In 2010, Russian and European experts continued to process the results of the scientific experiments carried out during the flight of the Russian unmanned spacecraft Foton-M3.

A major programme of research on zero-gravity physics, space materials science, space biotechnology and space biology was carried out.

(d) International cooperation

In 2010, Roskosmos contributed to the following main areas of international cooperation in the study and use of outer space for peaceful purposes:

(a) The launch of foreign payloads using Russian facilities;

(b) The construction of launch facilities and adaptation of Soyuz-ST carrier rockets for launch from the Guiana Space Centre, in cooperation with ESA, France and a number of European space enterprises;

(c) Cooperation in constructing advanced facilities for the future launch of heavy payloads (Ural project);

(d) Partnership in the construction and operation of ISS and in scientific research on board the Station;

(e) Cooperation in the development of new materials, bioproducts and other substances under microgravity conditions (using Foton-M satellites; the next launch of a Foton-M spacecraft is planned for 2013);

(f) Establishment of a Spektr-R X-ray observatory, with the extensive cooperation of foreign partners (ESA, the German Aerospace Center (DLR) and NASA);

(g) Fulfilment of the Russian Federation's commitments to the International Satellite System for Search and Rescue (COSPAS-SARSAT) (Sterkh spacecraft; one satellite is currently undergoing test flights; the second is being prepared for launch in the near future).

In order to foster international cooperation, inter alia, within the framework of facilitating implementation of the resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development", adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), the Russian Federation proposes the following activities:

(a) Carrying of payloads manufactured by other countries on Russian Meteor and Resurs satellites;

(b) Carrying of Russian scientific instruments on board foreign satellites within the framework of such projects as the NASA Lunar Reconnaissance Orbiter (LEND instrument) and the Mars Science Laboratory (Dynamic Albedo of Neutrons (DAN));

(c) Participation of the Russian Federation in the Global Monitoring for Environment and Security (GMES) programme and that of the Group on Earth Observations (GEO) (global monitoring of conditions in near-Earth space, the atmosphere, the Earth's land surface and water resources, and forecasting and monitoring of natural and man-made disasters, including monitoring of forest fires and forecasting of earthquakes and other emergency situations, using Meteor-M, Resurs-DK and other satellites);

(d) Participation of the Russian Federation in the implementation of the Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan;

(e) Participation in the work of the International Committee on Global Navigation Satellite Systems (ICG), which was set up as an unofficial body to promote cooperation on matters of mutual interest related to civilian satellite-based positioning, navigation and timing services, commercial services and the compatibility and interoperability of ICG systems.

Proposals have been drawn up for the Russian Federation to join the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (also called the International Charter on Space and Major Disasters), which provides for the coordination of Earth observation and the exchange of data and information in the event of natural or man-made disasters.

Operation of ISS as a permanently manned facility continued in 2010. Since 2009, the Station's international crew has increased to six persons. The Russian Federation, in addition to enhancing its segment of the Station and conducting a variety of scientific experiments aboard that segment while at the same time fulfilling its international obligations, uses manned Soyuz spacecraft and Progress cargo spacecraft to maintain and service ISS and ensure the safety of the crew in the event of emergency situations.

A plan for the further development of the Russian segment of ISS is under implementation. In 2009 and 2010, two mini research modules were put into operation. A multi-purpose laboratory module is to be launched in 2011. In the light of the decision taken by the heads of ISS partner agencies to extend the operation of the Station until 2020, Roskosmos invites all interested partners in space activities to take part in conducting research and experiments aboard the Russian segment of ISS.

The Russian Federation has the necessary range of facilities of proven reliability for the launch, at various inclinations, of payloads weighing from several hundred kilograms to 20 tons into near-Earth orbits. The Soyuz (Soyuz-2) and Proton (Proton-M) carrier rockets have been upgraded, and work is under way to develop future launch vehicles, including the Angara family of carrier rockets. For light satellite launches, Dnepr carrier rockets, and in some cases Sterkh and Rokot carrier rockets, are used.

To date, the Russian Federation has concluded numerous international agreements on cooperation in the exploration and use of outer space, including 42 inter-agency agreements signed by Roskosmos on joint space projects, launching methods and other areas.

(e) Space debris

Work on resolving the problems of space debris is included in several sections of the Federal Space Programme of the Russian Federation for the period 2006-2015.

Russian developers and operators of spacecraft and launch vehicles are subject to the requirements of the National Standard of the Russian Federation GOST R 52925-2008, entitled "Space technology: general requirements for space facilities to mitigate the man-made pollution of near-Earth space". The Standard has been brought into line with the provisions of the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space.

The principal measures to mitigate space debris applied to Russian carrier rocket stages, boosters and satellites in 2010 included the following:

(a) Full elimination of the possibility of structural components, parts and fragments from Breeze-M, DM-2 and three-stage Soyuz-2 carrier rockets being discarded in space;

(b) Selection of justified design features for the structural components of spacecraft and installation of meteorite shields on high-pressure units in order to prevent their rupture and destruction (Monitor-E, Resurs-DK1, Resurs-P, Spekr, Elektro-L, Bion-M and Breeze-M);

(c) Replacement, aboard the Ekran satellite, of batteries that use silver-cadmium accumulators — which are vulnerable to destruction as a result of explosion caused by the gases that they produce — with nickel hydrogen batteries;

(d) Elimination of intentional break-ups on all carrier rockets, boosters and satellites commissioned by Roskosmos;

(e) Depressurization of the fuel tanks of boosters following their transfer to a disposal orbit;

(f) Burning off of fuel remnants from the propulsion unit of the launch system following separation of the space object and the discharging of on-board accumulator batteries, and removal of reaction wheels, gyroscopes and other mechanical devices;

(g) Removal of fuel remnants under high pressure and discharging of chemical power sources on Ekspress-AM and Gonets satellites;

(h) Following completion of the flight mission of the Fregat booster, removal of the booster from orbit with subsequent splashdown in a predetermined location in the Pacific Ocean;

(i) Movement of Earth remote sensing satellites of the "Monitor" series following completion of mission from operational orbit to a lower orbit that ensures deceleration of the space object and burn-up in the atmosphere;

(j) The design features of the Sterkh satellites ensure less time in orbit owing to modification of the configuration of solar panels and other moving surfaces.

In the Russian Federation, work is being carried out to define the parameters of the space debris model (space debris prediction analysis) more precisely using compiled experimental data, to forecast man-made pollution of near-Earth space by establishing possible future scenarios of such pollution during the period 2025-2030, and in the longer term up to 2110, and to compare the results obtained with the corresponding results obtained by foreign models.

An important factor for dealing with the problem of space debris is the establishment of an inventory of the objects polluting near-Earth space within the geostationary orbit. To that end, the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences has organized an international network of observatories — the International Scientific Optical Observation Network (ISON) — to make astrometric and photometric observations, as a result of which it has been possible to record objects throughout the geostationary orbit. By the beginning of 2010, ISON facilities were tracking 1,467 objects in geostationary orbit (compared to the 1,016 objects on which data is provided by the space surveillance systems of the United States), including 892 satellites (391 operational and 501 non-operational), 250 carrier-rocket stages, boosters and apogee kick motors.

At the Keldysh Institute, a system for the prediction of near-collisions in the geostationary orbit using ISON measurements has entered into pilot operation, and the first forecasts have been issued at the Mission Control Centre of the Central Engineering Research Institute.

(f) Near-Earth objects

The main activities carried out as part of research on the problem of preventing collisions of asteroids and comets with the Earth include:

(a) Timely detection and monitoring of the movement of potentially dangerous celestial bodies;

(b) Determination of the characteristics of such bodies and timely risk assessment;

(c) Selection of methods and measures for actively influencing near-Earth objects, or development and implementation of other measures to reduce the risk to the population.

In order to ensure that the above-mentioned tasks are carried out, a space segment comprising facilities for the detection and tracking of dangerous objects may be created, the work of which would ensure improved quality of forecasts; advanced unmanned spacecraft may be used to study dangerous small celestial bodies at close range and to install beacons aboard spacecraft located in companion orbits near celestial bodies or on their surface. In addition, measures have been taken to actively influence celestial bodies that pose a threat to the Earth and to reduce the risk of their collision with the Earth.

Any measures to mitigate such threats would require the coordination of international efforts and expansion of the base of knowledge of the properties of near-Earth objects through the use of spectrographic analysis and near-Earth object fly-bys and landings.

The Russian Federation supports and is participating in the implementation of the recommendations of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space regarding the continuation of work in this area under the workplan for 2011, which envisages the expansion of joint activities to observe and analyse near-Earth objects at the national and international levels, the improved coordination of observations, the development of mechanisms for international cooperation and interaction in conducting observations and the establishment of a methodology for the development of procedures relating to the prevention of the threat at the international level.

Two international conferences on the threat to Earth posed by asteroids and comets have been held in the Russian Federation, organized by the Institute of Astronomy (Kazan, 21-25 August 2009) and the Institute of Applied Astronomy (Saint Petersburg, 21-25 September 2009) of the Russian Academy of Sciences. The results of research conducted in the above-mentioned areas were discussed at the two conferences.

Roskosmos has drawn up proposals for the use of space telescopes to observe asteroids and comets in space.

Roskosmos agencies are currently examining the scientific and environmental aspects of implementation of the following proposals:

(a) The mission of a Russian spacecraft similar to Phobos-Grunt to the asteroid Apophis with the aim of increasing the precision of predictions of the asteroid's "close encounters" with the Earth in 2036 and subsequent years, and research on the asteroid's physical and chemical characteristics;

(b) The construction of space telescopes capable of guaranteeing the detection and high-precision definition of the trajectory parameters of small (similar in size to the Tunguska meteorite) hazardous celestial bodies that cannot be detected using ground-based telescopes, and also for the high-precision calculation of the orbit of Apophis.

(g) Space weather

The Russian Federation has more than 20 years of experience in conducting observations of and research on space weather phenomena. The Applied Geophysics Institute of the Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) is both the main national centre for space weather forecasts and the European regional centre for reporting on space weather. Instruments for the observation of space weather operate on Russian Resurs-DK satellites and on the hydrometeorological satellite Meteor-3M, which was launched in 2009. In addition, a geophysical system of instruments is being installed on advanced Elektro satellites and in the Arktika space system.

Work has been stepped up in the Russian Federation to establish a system for monitoring the heliosphere and the Earth's atmosphere, consisting of ground-based and space-based segments.

The space-based segment comprises five satellites aboard which, inter alia, the following equipment is to be installed: radiophysical systems that use a wide range of frequencies (ionosondes) for monitoring the state of the ionosphere; equipment for the measurement of ionizing radiation; a system to monitor magnetic and wave activity; a dual-frequency transmitter of radio signals at frequencies of 150 to 400 MHz; global positioning system (GPS) receivers; and a diagnostics system to monitor solar activity.

The new system will include a ground-based complex for receiving, processing and distributing information. The deployment of the system will make it possible to perform tasks relating to the monitoring of and response to natural and anthropogenic effects on the upper atmosphere, the ionosphere and near-Earth space. The incorporation of the system in existing ground-based networks of measuring instruments will significantly increase the effectiveness of the overall system for the monitoring and forecasting of space weather.

(h) Nuclear power sources in outer space

Work in the Russian Federation to ensure the safe use of nuclear power sources in space is currently being carried out in the context of a project to construct a transport energy module with a megawatt-class nuclear propulsion system, implementation of that project having begun in 2010. The following international documents are being used in connection with that work as the main guidelines for ensuring safety:

(a) Principles Relevant to the Use of Nuclear Power Sources in Outer Space;

(b) Safety Framework for Nuclear Power Source Applications in Outer Space.

The transport energy module, which contains a nuclear power facility and an electrically powered cruise propulsion system fed by that facility and is intended to propel the space object and supply power to all its systems, is being developed in full conformity with the relevant United Nations documents.

In connection with the development of the transport energy module and in accordance with the provisions of the relevant international documents, national regulatory documents such as the General Regulations Governing the Safety of Nuclear Propulsion Systems, the Regulations Governing the Nuclear Safety of Nuclear Power Reactor Facilities aboard Unmanned Spacecraft and the Regulations Governing the Radiation Safety of Nuclear Power Sources in Space are currently being prepared in the Russian Federation with due regard to the provision of the Safety Framework for Nuclear Power Source Applications in Outer Space that states that activities occurring during the terrestrial phase of space nuclear power source applications, such as development, testing, manufacturing, handling and transportation, are addressed in national and international standards relating to terrestrial nuclear installations and activities.

Organizations that use nuclear power sources in space strive to achieve the fundamental goal of ensuring safety by complying fully with the relevant governmental and intergovernmental directives, requirements and procedures. The measures necessary to ensure such compliance in carrying out the transport energy module project have been implemented, including the establishment of a working group on regulatory documents relating to the nuclear and radiation safety of megawatt-class nuclear propulsion systems, the group comprising experts in that subject from all agencies participating in the project. The design and development processes thus ensure the highest possible level of safety. Information is provided to the public in a timely manner through the mass media.

The recommendation to ensure the highest level of safety that can reasonably be achieved, as contained in the Safety Framework for Nuclear Power Source Applications in Outer Space, is reflected in the selection of the altitude of the initial orbit for the transport energy module, aboard which the nuclear reactor is being installed. As is known, the lower the initial orbit, the more effective the use of nuclear power sources. According to the Principles Relevant to the Use of Nuclear Power Sources in Outer Space, the use of nuclear power sources in low-Earth orbits is permitted provided that those sources are stored in sufficiently high orbits after the operational part of their mission. In such cases, a very reliable operating system should be used to ensure the effective and controlled removal of the reactor to the sufficiently high orbit. However, the use of such a system reduces the level of safety. For that reason, at the current stage of design of the transport energy module, a sufficiently high orbit has been chosen as the initial orbit and as the orbit to which the transport energy module may return when operating in orbital transfer mode. Thus, safety has been given priority over effectiveness.

Following completion of the mission or in the event of an emergency situation, the reactor of the nuclear propulsion system will be brought to a subcritical state using the corresponding system, in line with the requirement set out in the Principles Relevant to the Use of Nuclear Power Sources in Outer Space that safety systems should be designed, constructed and operated in accordance with the general principle of defence in depth. Pursuant to that concept, foreseeable safety-related failures or malfunctions must be capable of being corrected or counteracted by an action or a procedure, possibly automatic. The reliability of systems important for safety is ensured, inter alia, by redundancy, physical separation, functional isolation and adequate independence of their components. The construction of the reactor for the nuclear propulsion system of the transport energy module complies fully with these principles.

The requirement established in the Principles Relevant to the Use of Nuclear Power Sources in Outer Space that the sufficiently high orbit must be such that the risk of collision with other space objects is kept to a minimum will also be met. In addition, the construction design of the reactor facility of the transport energy module will be selected on the basis of its resistance to damage caused by micro-meteorites and fine fragments of space debris.