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Space debris

Research on space debris, safety of space objects with nuclear power sources on board and problems relating to their collision with space debris

Note by the Secretariat

I. Introduction

1. At its fifty-sixth session, the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space agreed that Member States and international organizations having permanent observer status with the Committee should continue to be invited to provide reports on research on space debris, the safety of space objects with nuclear power sources on board, problems relating to the collision of such space objects with space debris and the ways in which debris mitigation guidelines were being implemented (see A/AC.105/1202, para. 143). Accordingly, a communication dated 15 July 2019 was sent to Member States and international organizations with permanent observer status, inviting them to provide their reports by 21 October 2019 so that the information could be made available to the Subcommittee at its fifty-seventh session.

2. The present document has been prepared by the Secretariat on the basis of information received from two Member States, namely Algeria and the Russian Federation.

* A/AC.105/C.1/L.383.

II. Replies received from Member States

Algeria

[Original: French]
[31 October 2019]

The Republic of Algeria does not yet have in place a national mechanism for space debris mitigation given its recent entry in the space field and the number of satellites it has in orbit. However, the issue is of particular importance to Algeria because of its size, the density of its population and the growing number of space objects in orbit over its territory.

Algeria welcomes the work of the Office for Outer Space Affairs of the Secretariat to promote international collaboration and foster progress in this area; and it reiterates its support for the efforts of the international community to reduce space debris and protect the orbital and suborbital environments. It also reiterates its support for the voluntary implementation of the guidelines on space debris mitigation that were established by the Inter-Agency Space Debris Coordination Committee with a view to combating the danger posed by the proliferation of space debris while not hindering the development of the emerging space capabilities of developing countries.

In addition, Algeria, which is actively participating in the Working Group on the Long-term Sustainability of Outer Space Activities, has joined the initiative of Canada, Czechia and Germany by completing the questionnaire concerning standards for space debris mitigation, which is regarded as an innovative document containing information from Member States on national measures to reduce space debris and which may serve as a starting point for future reflection.

With regard to the safety of space objects with nuclear power sources on board, Algeria, which actively participates in the work of the Committee on the Peaceful Uses of Outer Space and its two subsidiary bodies and endorses the principles related thereto, is concerned about the possible consequences of the use of such power sources in outer space, which would undermine any form of long-term sustainability of outer space activities and the preservation of outer space as the common heritage of humankind for future generations.

For that reason, it recalls the provisions of article IV of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) of 1967, which stipulates that “States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.”

Algeria considers it essential that States pay greater attention to the potential consequences of the use of nuclear power sources, and it supports all initiatives involving the transfer of expertise in that area, in order to enable all States that wish to make use of power sources in space to do so safely.

Russian Federation

[Original: Russian]
[28 October 2019]

Report on activities to reduce the human-caused pollution of near-Earth space

Conjunction monitoring, risk assessment and manoeuvres carried out by the International Space Station to avoid collision with space debris objects

From January to August 2019, the Ballistics and Navigation Service of the Central Engineering Research Institute’s Mission Control Centre received alerts from

the National Aeronautics and Space Administration (NASA) Johnson Space Center warning of the likelihood of breaches of the safety zone of the International Space Station by 26 “space objects of risk”, including a warning that the zone would be breached at ±0.75 km vertically, a distance of ±25 km along the Station’s orbital path and at ±25km laterally, and that the probability of collision was Pc>10-6. In total, some 119 alerts were received.

On the basis of the results of tracking of the space objects of risk, three of those objects were identified during the early stages of their tracking as being in danger of committing critical breaches of the International Space Station safety zone, as a result of which avoidance manoeuvres would be required. In the process of further assessing the said objects of risk on the basis of probability criteria, it was determined that avoidance manoeuvres were not needed. Among the above-mentioned 24 space objects of risk, four were determined to be so-called uncatalogued objects, namely objects that have no international designation and are not assigned an official number in the United States Strategic Command (USSTRATCOM) catalogue.

The most recent manoeuvre of the International Space Station to avoid collision with a space object of risk was performed on 27 September 2015 using the engines of the Progress M-28M cargo spacecraft, located on the SO-1 docking module, which had docked on the lower port of the docking module of the Russian segment of the International Space Station.

Using the instruments of the Russian automated warning system for hazardous situations in near-Earth space, over the period January–August 2019, there were 63 violations of the four-kilometre safety zone of the International Space Station, 17 of which matched alerts from the mission control centre MCC-X.

Automated warning system for hazardous situations in near-Earth space

Under the auspices of the State Space Corporation “Roscosmos”, the Russian Federation has put in place and, since 1 January 2016, has been successfully operating an automated warning system for hazardous situations in near-Earth space.

The system is intended to ensure the safety of space activities, issue warnings of hazardous situations in near-Earth space to users and ensure compliance by the Russian Federation with its international obligations in relation to space debris.

The main tasks carried out by the system are the following:

- Collection, processing, analysis, systematization and cataloguing of information on space objects posing a potential hazard to crewed and non-crewed spacecraft and on the situation in near-Earth space derived from all available sources
- Detection, forecasting, analysis and ballistic monitoring of hazardous situations in near-Earth space, including the conjunction of space objects with satellites belonging to the orbital constellation of the Russian Federation, the uncontrolled de-orbiting of high-risk space objects and verification of the destruction of space objects
- Monitoring of the implementation of measures to remove spent stages of carrier rockets, boosters and spacecraft to disposal orbits or limited-lifetime orbits
- The communication to users of information on hazardous situations in near-Earth space and on the predicted development of such situations

Through the use of the automated warning system, the Russian Federation is able to participate in international test campaigns to track hazardous space objects that have ceased to function in orbit.

Information on the occurrence and forecasting of hazardous situations in near-Earth space is sent to the Roscosmos Central Information Unit, the main operational control team of the Russian segment of the International Space Station, the sectors responsible for the control of satellites used for scientific research and socioeconomic applications at the Central Engineering Research Institute’s Mission

Control Centre and the following main satellite operators: the Research Centre for Earth Operative Monitoring, the Academician Reshetnev Information Satellite Systems (a joint-stock company), the Russian Satellite Communications Company (a federal State unitary enterprise) and the Mission Control Centre of the Lavochkin Research and Production Association.

In structural terms, the automated warning system comprises several separate segments, each of which performs functions specific to that segment and which together form a cohesive system, ensuring, through their joint operation, the performance of the tasks assigned to the automated warning system.

The automated warning system is made up of the following components:

- Central Information and Analysis Centre
- Segment for the monitoring of hazardous situations in geostationary, highly elliptical and medium-altitude orbits
- Segment for calculating the parameters of solar and geomagnetic activity
- Array of specialized electro-optical instruments, located both in the Russian Federation and abroad

The various segments and the specialized electro-optical instruments are used to carry out the tasks assigned to the automated warning system's Central Information and Analysis Centre.

There is an automated flow of information between the Central Information and Analysis Centre, the different segments and the array of specialized electro-optical instruments. The procedure for this information flow is laid down in the relevant provisions and protocols on information exchange.

For the automated warning system, the primary sources of information on space objects in near-Earth space are the following:

- Specialized electro-optical instruments of the automated warning system
- Facilities of the space surveillance system of the Ministry of Defence of the Russian Federation
- Facilities of the scientific network of optical instruments for astrometric and photometric observations, operating under the management of the Keldysh Institute of Applied Mathematics
- Open-access information sources

During the period from January to August 2019, more than 25 million measurements relating to more than 10,000 objects in various orbits, including geostationary, high-elliptical, high-altitude near-circular and low orbits, were taken using the electro-optical instruments of the automated warning system and appropriate space monitoring instruments.

As at 31 August 2019, a total of 22,185 space objects had been catalogued in the suite of databases at the automated warning system's Central Information and Analysis Centre, including 2,298 as yet unidentified objects. Among the 19,887 identified objects, 2,372 were active satellites and 17,515 were pieces of space debris, including:

- 2,865 non-functional spacecraft
- 2,070 boosters and carrier rocket final stages
- 12,580 fragments of spacecraft, boosters, final stages of carrier rockets and other operational components

In 2019, instruments of the automated warning system were used to carry out the periodic monitoring of hazardous conjunctions of human-made space objects with

the International Space Station and with satellites belonging to the orbital constellation of the Russian Federation, which included:

- Resurs-P Earth remote sensing system (2 satellites)
- Elektro-L No. 2 geostationary meteorological satellite
- Luch-5 space communications and relay system (3 satellites)
- Canopus-V Earth remote sensing system (6 satellites)
- Ekspress system of geostationary telecommunications satellites (11 satellites)
- Yamal system of geostationary telecommunications satellites (5 satellites)
- GLONASS space navigation system (27 satellites)
- Gonets-D1M space communications system (12 satellites)
- Spektr-R space-based astrophysical observatory
- Meteor-M space-based system for hydrometeorological and oceanographic support (3 satellites)
- Yubileiny-2 (MiR) scientific experimental satellite
- Aist-1, Aist-2 and Aist-2D research and experimental satellites
- Reflektor small calibration satellite
- Etalon calibration and coordinate-measuring spheres (2 satellites)
- Mikhailo Lomonosov research satellites

The satellites used for scientific research and socioeconomic applications as part of the Resurs-P, Elektro-L, Luch-5 and Canopus-V space systems are controlled from the Mission Control Centre of the Central Engineering Research Institute.

Between January and August 2019, the Central Information and Analysis Centre of the automated warning system detected 63 breaches of the four-kilometre safety zone of the International Space Station and recorded 2,075 instances of the hazardous passage of pieces of space debris, which breached the 1.5-kilometre safety zone of the satellites of the Russian orbital constellation, including:

- 122 hazardous conjunctions of space objects with the satellites of the Resurs-P space system
- 875 hazardous conjunctions of space objects with satellites of the Canopus-V space system
- 265 hazardous conjunctions of space objects with satellites of the Meteor-M space system
- 17 hazardous conjunctions of space objects with satellites of the GLONASS space system
- 2 hazardous conjunctions of space objects with satellites of the Ekspress space system
- 317 hazardous conjunctions of space objects with satellites of the Gonets-M space system
- 50 hazardous conjunctions of space objects with the Reflektor satellite
- 21 hazardous conjunctions of space objects with the Yubileiny-2 (MiR) satellite
- 80 hazardous conjunctions of space objects with the Mikhailo Lomonosov satellite
- 326 hazardous conjunctions of space objects with Aist satellites

In 2019, the automated warning system recorded the transfer to a disposal orbit of the following:

- Japanese telecommunications satellite N-SAT 110 (international designator 2000-060A)
- Chinese telecommunications satellite Fengyun-2D (international designator 2006-053A)
- Greek telecommunications satellite Hellas-Sat 2 (international designator 2003-020A)
- European telecommunications satellite AMC-10 (international designator 2004-003A)
- United States military communications satellite FLTSATCOM-7 (USA-20) (international designator 1986-096A)
- Canadian telecommunications satellite Nimiq-2 (international designator 2002-062A)
- European telecommunications satellite NSS-6 (international designator 2002-057A)
- Norwegian telecommunications satellite Thor-3 (international designator 1998-035A)
- Chinese telecommunications satellite Apstar-5 (international designator 2004-024A)

In addition to space objects launched into orbit in 2019, the monitoring instruments of the automated warning system detected more than 1,000 previously unknown high-orbit fragments of space debris, including break-up fragments of the United States Centaur upper stages (international designators 2009-047B and 2018-079B).

During the period from January to September 2019, the Central Information and Analysis Centre of the automated warning system provided support for the de-orbiting of 102 space objects of risk. Forecasts of the re-entry times and locations in which the space objects were predicted to land were submitted to the Roscosmos Central Information Unit.

Under the Federal Space Programme for 2016–2025, it is planned to further develop the automated warning system through the creation of new and the upgrading of existing electro-optical observation facilities and the deployment of those facilities not only in the territory of the Russian Federation but also in other countries, and through the improvement of existing and the establishment of new hardware and software systems.