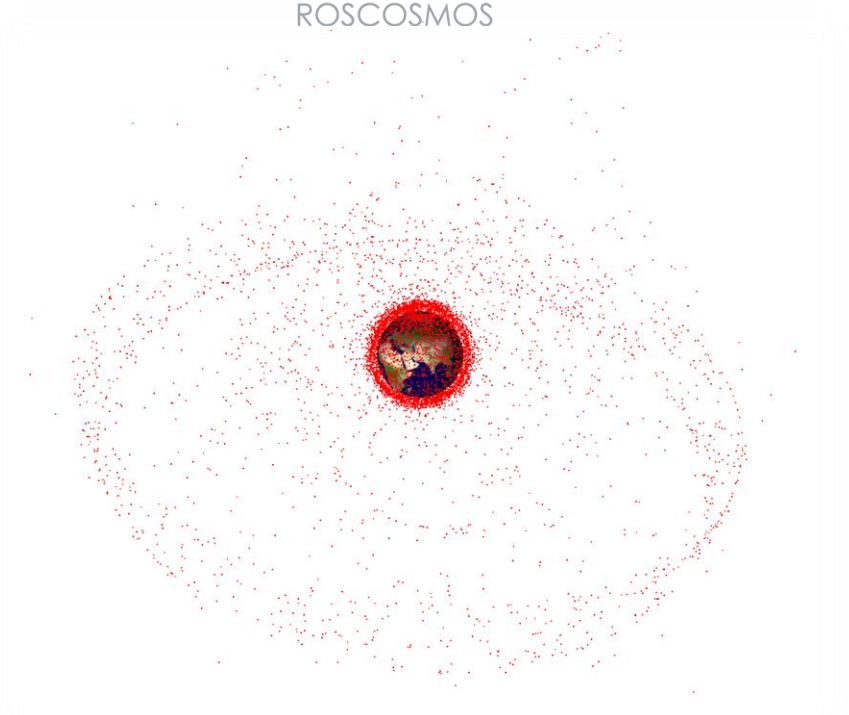
ROSCOSMOS



Activities of the Russian Federation on space debris research in 2016

United Nations Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Fifty-fourth session
2017

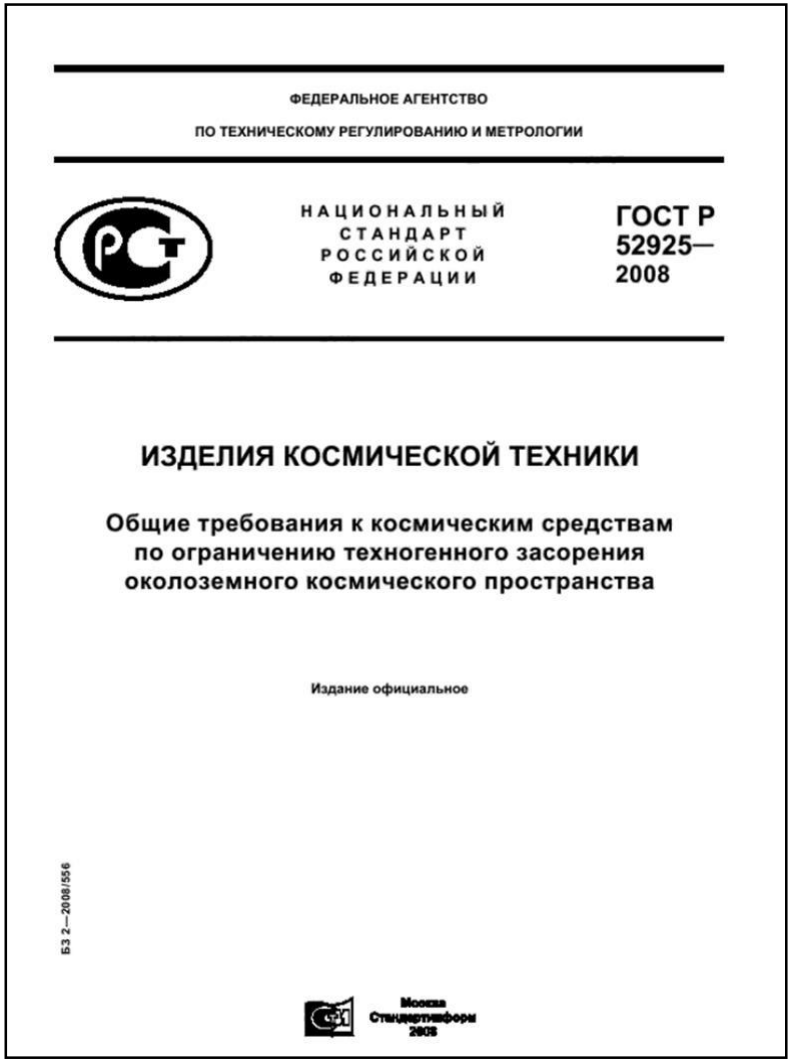
Update of the national standard GOST R 52925-2008

Main changes in the GOST R 52925-2008:

Updated definitions: near-Earth space, orbital lifetime, probability of successful disposal, break-up

Requirement for altitude of perigee over LEO and GEO protected regions after disposal: altitude must be high enough to prevent the return of spacecraft into protected regions at least during 100 years

New section: probability of successful disposal of a space system must be no less than 0,9. This probability is calculated based on the assessment of reliability of subsystems used for disposal. It is assumed that there is a sufficient amount of on-board resources required for the performance of disposal



ФЕДЕРАЛЬНОЕ АГЕНТСТВО

ПО ТЕХНИЧЕСКОМУ РЕГУЛИРОВАНИЮ И МЕТРОЛОГИИ

НАЦИОНАЛЬНЫЙ СТАНДАРТ РОССИЙСКОЙ ФЕДЕРАЦИИ

ГОСТ Р 52925— 2008

ИЗДЕЛИЯ КОСМИЧЕСКОЙ ТЕХНИКИ

Общие требования к космическим средствам по ограничению техногенного засорения околоземного космического пространства

Издание официальное

БЗ 2—2008/556

Москва Стандартинформ 2008

Implementation of space debris mitigation requirements for existing and planned missions and launch vehicles (1)

Limiting debris released during normal operations
(LV: "Soyuz" series, SC: "Meteor-M", "Ekspress" series, "Resurs" series)

Minimizing a possibility of accidental break-up during flight operations by choosing a reasonable safety margin for spacecraft structural elements subjected to mechanical stress, inclusion of protection elements in the design of high-pressure units (fuel tanks, high-pressure tanks, pipes, sealed compartments, etc.) in order to prevent their rupture and spontaneous break-up
("Volga" upper stage, LV: "Soyuz" series, SC: "Obzor-R", "Bion-M", "Ekspress" series, "Resurs" series)

Reducing a probability of accidental collisions in orbit by an appropriate choice of orbital parameters, applying safe spacecraft collocation strategy in one orbital position in GEO, prediction of risky conjunctions, installation of propulsion systems with increased fuel capacity to support avoidance manoeuvres
(SC: "Meteor-M", "Zond", "Ekspress" series, "Resurs" series)

Measures to prevent intentional destruction of any launch vehicles, orbital stages and spacecraft developed by ROSCOSMOS

Implementation of space debris mitigation requirements for existing and planned missions and launch vehicles (2)

Minimizing a possibility of break-ups upon completion of missions by means of pressure dumping in fuel tanks of LV orbital stages after their transfer to a disposal orbit

(stages of LV of "Soyuz" series, "Volga" upper stage)

Venting remained fuel under high pressure, complete discharging of chemical batteries and disconnecting batteries from charging sources, burning residual propellants

(SC: "Ekspress" series, "Resurs" series)

Limiting a long-time presence of spacecraft and orbital stages of launch vehicles in LEOs upon completion of missions by means of appropriate manoeuvres into a disposal orbit where a ballistic lifetime of an object will not significantly exceed approximately 25 years

(LV: "Soyuz" series, SC: "Meteor-M", "Kanopus" series)

Limiting long-time presence of spacecraft and orbital stages of launch vehicles in GEO protected region upon completion of missions by means of re-orbiting to a graveyard orbit at the height of 250-300 km above the geostationary orbit

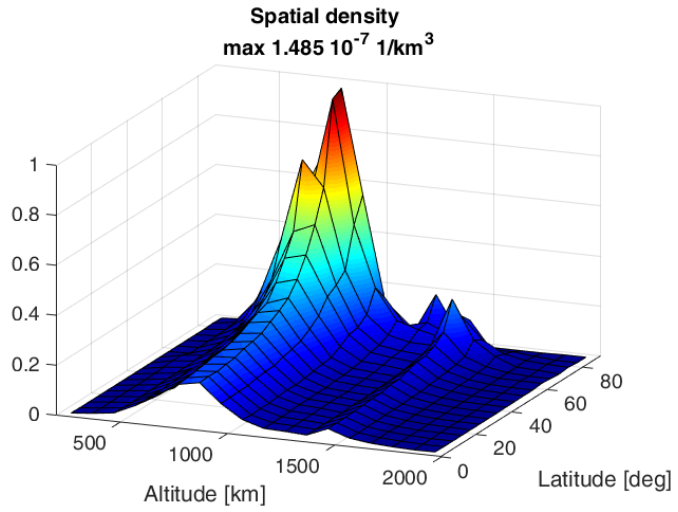
(DM-2M upper stage, SC: "Ekspress" series)

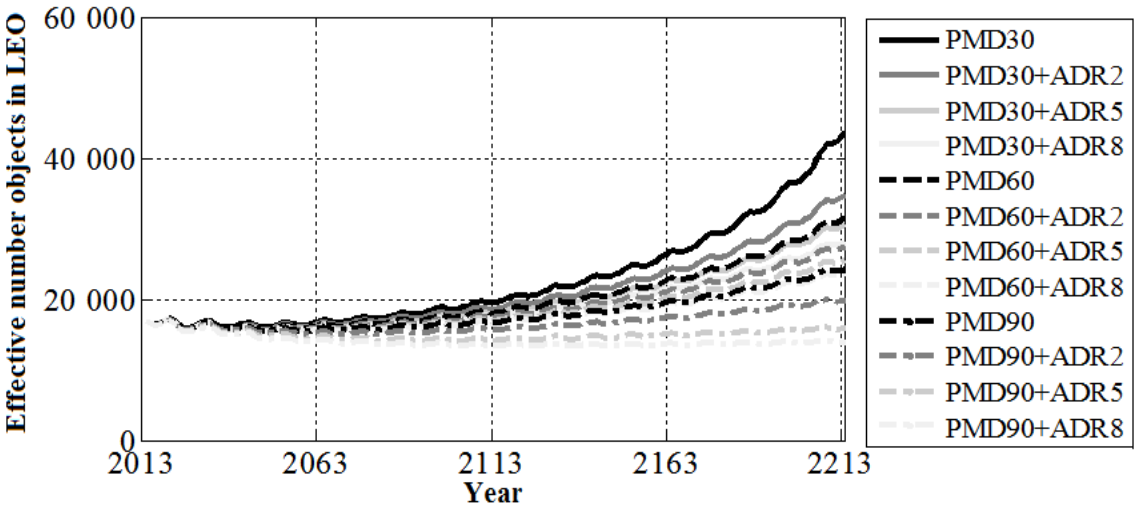
National research on space debris modeling

In 2016 the Russian model of space debris – Space Debris Prediction and Analysis (SDPA) – was further improved

Now it covers all altitude ranges up to 40 000 km and encompasses both space debris and micrometeoroids. Model parameters are updated on the basis of new experimental data obtained in 2016

A prediction technique for assessing space debris population in the LEO region (up to 2000 km) for objects lager than 10 cm taking into account collisions between objects and active debris removal of large-sized space debris fragments is developed

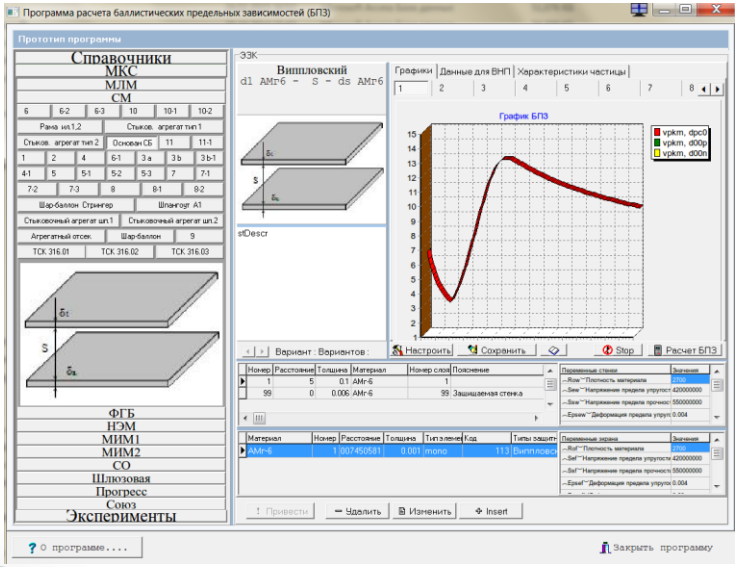


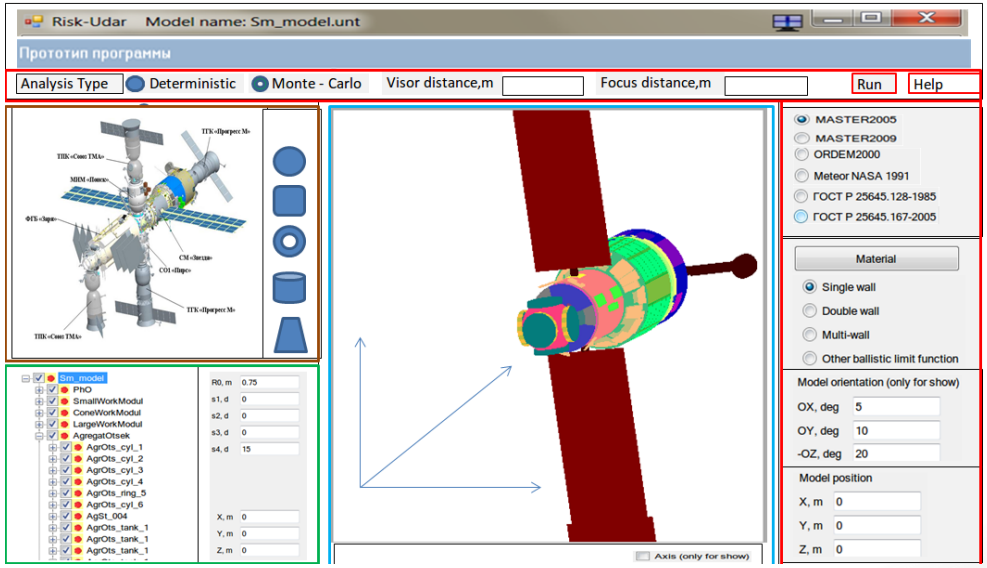


National research on the impact on safety due to spacecraft hypervelocity increase

Experimental installations, which allow to accelerate projectiles up to a speed of 8 km/s, are used for research on the impact effects

A second version of the "Risk-Udar“software (the Russian analog of BUMPER (NASA) and ESABASE-2 (ESA) software tools) was developed in 2016 and verified according to IADC recommendations





Automated Warning System on Hazardous Situations in Outer Space (ASPOS OKP)

Put into regular operation on January 1st, 2016

Automated Warning System on Hazardous Situations in Outer Space (ASPOS OKP)

ASPOS OKP electro-optical observation

Optical measurements of objects in GEO, HEO and MEO

Observation tasks

Information from Space Surveillance System

Information on objects in LEO

TASKS

- Processing of measurements, estimation of orbital parameters
- Estimation of physical properties of objects
- Conjunction analysis
- Analysis of operations on re-orbiting to graveyard orbits
- Pre-launch conjunction analysis
- Fragmentation analysis
- Analysis of uncontrolled re-entry

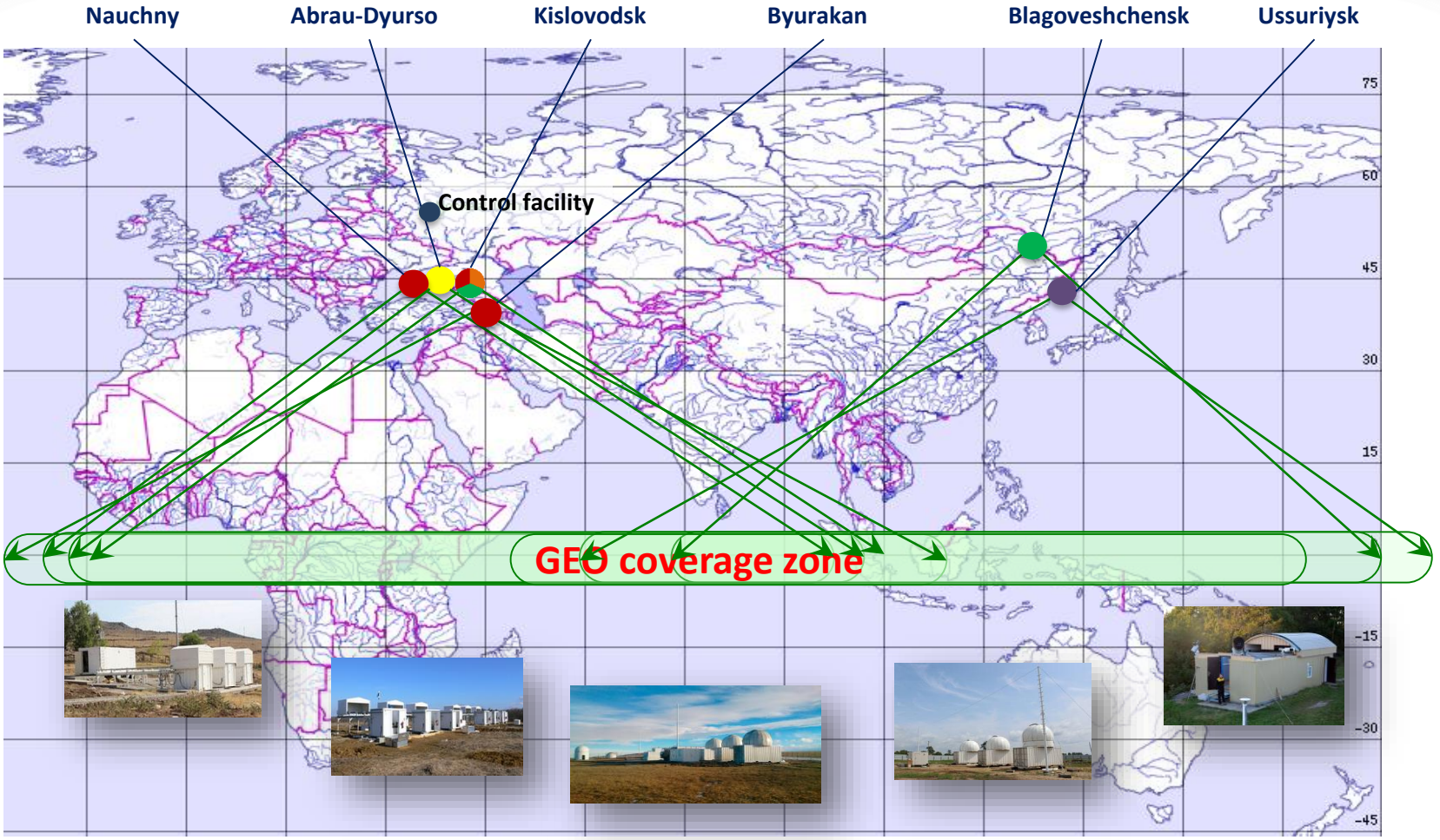
Information for test campaigns → **IADC**

Notifications on close conjunctions → **Spacecraft control centers (operators)**

Planned manoeuvres ← **Spacecraft control centers (operators)**

Analysis of risks → **ROSCOSMOS**

Operational optical facilities of ASPOS OKP



EOP-1 (4 facilities)
Each facility includes
2 telescopes with 19 cm aperture
1 telescope with aperture 25 cm
1 telescope with aperture 40 cm

EOP-2 (2 facilities)
Each facility includes
4 telescopes with aperture 19 cm
1 telescope with aperture 40 cm
1 telescope with aperture 65 cm

OES-50

OES-65

RKS-25

Total:
21 telescopes

Space debris measurements
The ISON project

- International Scientific Optical Network (ISON) working under auspices of Keldysh Institute for Applied Mathematics, RAS, continues to improve
- It allows to provide observation of objects along the entire GEO arc
- Six new telescopes, including a 80-cm telescope at Terskol Peak (North Caucasus), were put into operation
- The second observatory in Mexico (Monterey) started to provide observations

ROSCOSMOS

Thank you for attention!

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