

SPACE DEBRIS SYMPOSIUM (A6)
Mitigation and Standards (4)

Author: Dr. Michael Yakovlev
Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation,
Michael.V.Yakovlev@tsniimash.ru

Dr. Yuriy Makarov
Roscosmos, Russian Federation, ynmakarov@yandex.ru
Prof. Andrey Nazarenko
Space Observation Center, Russian Federation, nazarenko@iki.rssi.ru
Prof. Gennady Raykunov
Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation,
graykunov@yandex.ru
Prof. Valery Trushlyakov
Omsk State Technical University, Russian Federation, vatrushlyakov@yandex.ru
Mr. D. Gorobets
Russian Federation, Michael.V.Yakovlev@tsniimash.ru
Mr. V. Kudentsov
Russian Federation, Michael.V.Yakovlev@tsniimash.ru

PREDICTION OF NEAR-EARTH SPACE DEBRIS POPULATION AND FUTURE SPACE OBJECT
DISPOSAL MEASURES**Abstract**

The Russian SDPA (Space Debris Prediction and Analysis) model for determining the level of near-Earth space (NES) debris population has been modified. The near-earth space debris population state has been calculated for the 200 year prediction interval taking into account the mechanism of space debris mutual collisions. The data obtained are correlated with the prediction data of similar NASA and ESA models. It is shown that currently mutual collisions of space debris fragments contribute to uncontrolled growth of space debris population (Kessler's effect). Further steps to secure space mission safety in space debris environment should include a number of measures and first of all an obligatory compliance of space activity with the "Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space". At the same time some additional measures are highly relevant and one of them is the removal of large debris fragments from operational orbits to burial zone thus reducing the probability of space debris generation. Removal of spent SLV upper stages using gasified remaining propellants is considered to be an efficient method of solving the given problem. Some aspects of this method are under discussion. Technologies of debris removal include such operations as disclosure of interested space object, pointing and approach of active spacecraft to the chosen object, the set of planned operations above the object. So the same technologies may be used not only for civil but either for military operations. There is presently no binding legal instrument specifically obligating space-faring actors to remediate the space debris situation. However, there is a clear evolution in international law towards the imposition of such an obligation. Future treaties or political agreements on space debris remediation should be oriented for preventing deployment and tests of weapons in outer space. Scientific and Technical Subcommittee of UN COPUOS may be considered as a relevant platform for investigating legal and political aspects of space debris remediation in frame of the general problem of long term sustainable space activity. The sequence

of the first priority organizational procedures and related items of international law for debris remediation are under discussion.