

Promoting Space Sustainability

GISTDA**[24 February 2021]**

Implementation of the Guidelines for the Long-term Sustainability (LTS) of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space

Operational Case Studies

I. Short description of the outer space activity [1000-word max.]

Since 2009, Geo-Informatics and Space Technology Development Agency known as “GISTDA”, Thailand has performed two major the space activities regarding the safety uses of outer space.

Firstly, we have promoted the registration of space objects launched into outer space. Thailand is one of the active States Parties of the Outer Space Treaty and ratified it in 1968. Thailand also ratified Rescue Agreement in 1969 and has been a member of UNCOPUOS since 2004. Even though Thailand is not a party to the Convention on Registration on Objects Launched into Out Space Registration Convention (1975), Thailand, on voluntary basis, registered the THEOS-1 Satellite with UNOOSA on 27 January 2009. However, numbers of space objects (satellites) in Thailand will significantly increase in near future. As a result, we are aware of the serious importance for the registration of space objects. Therefore, the internal process regarding the registration of objects launched into outer space was developed and officially approved by the Cabinet of Thailand on June 2nd, 2020.

Secondly, according to the huge increment of space utilization in commercial companies proposes to launch small satellites in mega-constellations. The expected growth of space object population results in the significant number of close encounters or Conjunction Data Messages (CDMs). This situation leads to increase potential collision risk to active satellites that is big challenge for all operators to manage the collision risk. As a result, GISTDA initiated to develop the space traffic system known as “ZIRCON” to monitor and warn all potential risks of space objects to Thailand satellites. ZIRCON is capable of screening possible on-orbit collisions of all trackable objects provided by Space-Track.org and the screening results of ZIRCON provide the essential analysis (miss distance, Time of Close Approach (TCA), collision probability and visualization) to support operators for a decision and planning of avoidance maneuver. The goal of the first phase starts implementing to monitor the potential risks for GISTDA’s satellites that has implemented since Dec 2020.

The second phase is to provide the collision risk for all Thailand satellites before servicing in the international level that is the ultimate goal. Furthermore, the architecture design of ZIRCON will be developed to expand multiple functions such as autonomous maneuver planning, radio frequency interference, space weather monitoring and forecast and then launch and re-entry conjunction assessment. These are planned to achieve within 6 years.

II. Connection with the LTS Guidelines [500-word max.]

The register space objects launched into outer space directly connects to **A.5: enhance the practice of registering space objects**. Refer to the cabinet resolution, GISTDA is the national focal point for the space object registration submission to United Nations Office for Outer Space Affairs (UNOOSA). After the satellite is launched into Outer Space, the satellite operators (in Thailand) are required to complete the space object registration form provided by UNOOSA and send to GISTDA (for submission approval). (After approval) GISTDA will send the space object registration information to The Ministry of Foreign Affairs (of Thailand), which responsible for a protocol arrangement before submitting the space object registration submission form to (the Director of) UNOOSA.

ZIRCON is developed by Astrodynamics Research Laboratory or Astrolab that is a main research laboratory of GISTDA to conduct four research areas in space flight dynamics, onboard flight software, space debris and asteroid mitigation and space weather areas connecting with the LTS Guidelines in several topics. Our executive management is aware of the space technology and innovation that is one of major key for the new space economy. Therefore, they provide the funding to research and develop ZIRCON including training to improve our expertise and knowledge in space flight dynamics. These connect to **B.4 Perform conjunction assessment during all orbital phases of controlled flight and C.3 Promote and support capacity-building**. In next 6 years, ZIRCON will be implemented on key functions of ZIRCON as mentions in section I. It leads to enhance the capability to provide the analyzed data of space weather and launch and re-entry. These connects to more 3 Guideline: **B.5 Develop approaches for pre-launch conjunction assessment, B.6 Share operational space weather data and forecasts and B.7 Develop space weather models and tools and collect established practices on the mitigation of space weather effects**

III. Lessons learned [500-word max.]

Pointing at the risk of space object collision

There are a huge number of satellites of many nations planned to launch into outer space in near future. Raising the fact that the risk of space object collision is dramatically increased as well as pointing at measures that can help avoiding that risk, the National Space Policy Committee (of Thailand) then realized the importance of the registration. Therefore, the endorsement of the procedure of objects launched into outer space submissions took shorter time than we thought. And later, it was officially approved by the cabinet of Thailand.

The latest exciting event on the high possibility on collision of space objects took place in the beginning of February 2021, when ZIRCON assessed the very short distance between THEOS-1(Thailand's EO satellite) and the space object. This precaution allowed GISTDA to have time to determine and plan on collision maneuver of the THEOS-1 satellite to avoid possible damage of the conjunction event. The execution of the satellite maneuver control was taken into account of efficient fuel consumption and continuity of satellite's mission. The successfulness of this assurance on safety of satellite operation can be increase reliability of the operators for other space missions.

However, both ZIRCON and THEOS-1 satellite are owned by GISTDA, therefore, the communication from the assessment system can flow smoothly to the satellite operation system. In case of the system will be opened to service other satellites, some coordination platform might be set up among the service provider and recipients for communication such as requests, warnings, and feedbacks.

The on-orbit servicing by ZIRCON with supplementing from orbital mechanics research and development will be improved to assess other space situation pertaining to safety of operation and effects human activities on the Earth. We hope that the missions can be one part to support full international space traffic management system in the future and promote the adopted LTS Guidelines with practices implemented by a developing country.