وكـالة الإمـارات للفضـاء
UAE SPACE AGENCY

2022

Space Debris Mitigation Guidelines

Regulatory Framework on Space Activities of the United Arab Emirates

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The UAE Space Agency (The Agency),

Recognizing the importance of long-term sustainability of Identified Area, in which space accessibility is the right of all nations for peaceful use purposes and for the benefit of all humanity.

Considering the common interest of nations, which recognize the need to reduce the threat of Space Debris associated with Space Activities, and are currently acting within different international fora to mitigate the creation of new debris in future missions.

Recognizing Space Debris mitigation standards and best practices developed by the Inter-Agency Space Debris Coordination Committee (IADC) being endorsed by the United Nations (UN), the International Telecommunication Union (ITU) and the International Organization for Standardization (ISO).

Following these initiatives, and given the importance of the subject, The Agency hereby issues this Space Debris Mitigation Guidelines (The Guidelines) to any Operator in line with international standards and best practices.

Board of Directors of the UAE Space Agency:

- After perusal of the Constitution;
- Federal Law No. (1) of 1972 Competencies of the Ministries and Powers of the Ministers and its amendments;
- Federal Law No. (12) of 2019 on the Regulation of Space Sector;

- Pursuant to the proposal of the Director General of the UAE Space Agency, and the approval of the Board of Directors,

Decides:

Section (1)

Definitions

In the Implementation of the provisions of this Regulation, the following terms and expressions shall have the meanings assigned against each, unless the context requires otherwise:

State	:	The United Arab Emirates.
Government Entities	:	Ministries, public authorities and institutions, and other federal or local government Entities in the State.
Agency	:	The UAE Space Agency.
Board of Directors	:	The Agency's Board of Directors.
The Law	:	Federal Law No. (12) of 2019 on the Regulation of the Space Activities.
Launching State	:	The state that launches or procures the launching of Space Object, or the state from whose territory or facility a Space Object is launched.
Accident	:	An event resulting from Space Activities, Space-Support Flights or High Altitude Activities that causes death, or severe injury of a Person or destruction, or massive damage to a Space Object, an aircraft used on a Space-Support Flights, high altitude activities or to properties on board, or destruction of severe damages to any object or property in the air or on the surface of the Earth.
Incident	:	An event resulting from Space Activities, Space-Support Flights or High Altitude Activities that affects or may affect the safety of such activities, or the operation of a Space Object or an aircraft used for a Space-Support Flights, or the high altitude activities, or causes or may cause damage to a Person or to any object or properties in the air or on the surface of the Earth, provided that

		the damage resulting from such event does not amount to the level of the accident.
Space Activities	:	Activities that target the Identified Area, including its discovery, making an impact thereon, using, or utilising it, in accordance with the provisions of Article (4) of the Law.
Orbital Space Flight	:	A Spaceflight with the intention of completing an orbit around the Earth.
Sub-Orbital Space Flight	:	A Spaceflight with the intent to enter the Identified Area without the intention of completing an orbit around the Earth.
Spaceflight	:	A space activity where a Space Object transporting individuals, living things, equipment, or other payloads to or through the Identified Area, or returning therefrom, whether that flight is orbital, sub-orbital, or above the Earth's orbit.
Authorization Regulation	:	Regulation issued by the Agency in relation to the Authorization of Space Activities.
Break-up	:	Any event that generates fragments, which are released into earth orbit and which may include the break-up of a Space Object, including: 1. An explosion caused by the chemical or thermal energy from propellants, pyrotechnics and other elements. 2. A rupture caused by an increase in internal pressure. 3. A Break-up caused by energy from collision with other objects. 4. A Break-up during the Re-Entry phase caused by aerodynamic forces. 5. The generation of fragments, such as paint flakes, resulting from the ageing and degradation of a Space Object.
Design and Manufacturing Phase	:	Begins with the definition and production of a Space Object or a Launch Vehicle and continues up to the beginning of the Launch phase.

Launch Phase	:	Begins by the detachment of the launch vehicle from the equipment and ground installations that made its preparation and ignition possible (or when the Launch Vehicle is dropped from the carrier-aircraft, if any), and continues up to the end of the mission assigned to the Launch Vehicle
Mission Phase	:	The phase where the Space Object fulfils its mission. Begins at the end of the Launch phase and ends at the beginning of the Disposal Phase.
Disposal Phase	:	Begins at the end of the Mission Phase and ends when the Space Object has performed the actions to reduce the hazards it poses to other Space Objects.
Equatorial Radius of the Earth	:	The Equatorial Radius of the Earth is taken as 6,378 km and this radius is used as the reference for the earth's surface from which the orbit regions are defined.
Geostationary Earth Orbit (GEO)	:	Earth orbit having zero inclination and zero eccentricity, whose orbital period is equal to the earth's sidereal period. The altitude of this unique circular orbit is close to 35,786 km.
Geostationary Transfer Orbit (GTO)	:	An Earth orbit, which is or can be used to transfer a Space Object from lower orbits to the geosynchronous region. Such orbits typically have perigees within LEO region and apogees near or above GEO.
Graveyard Orbit	:	Orbit about 300 km or more above a GEO or GSO into which spent upper stages or satellites are injected to reduce the creation of debris in GEO or GSO.
Launch	:	The process of launching, or attempting to launch a Space Object in and into Identified Area, including all preparations and necessary activities at the Launch site, up to the stage of payload separation, until the complete separation of the Payload from the head of the Space Object.
Launch Vehicle	:	A Space Object used for the purpose of transporting a payload, other Space Objects, individuals, living things, equipment, or other things to or through, or from the Identified Area or

returning therefrom, whether or not that flight is orbital, sub-orbital, or above the Earth's orbit.

Launch Vehicle Orbital Stages	:	Any stage of a Launch vehicle left in Earth orbit.
Nominal Operation	:	Any Space Object operating without internal failure and according to the operational design of the manufacturer and the operation procedures of the Operator.
Special Operation	:	Any Space Object operating in non-nominally Operation or requiring active control from the Operator.
Operator	:	A Person who carries out Space Activities, Space-Support Flight activities, High-altitude Activities, Space data management and dissemination activities, or any other relevant activities subject to this Law.
Authorization Regulation	:	Regulation issued by the Agency in relation to the authorization of Space Activities.
Identified Area	:	An area eighty kilometres or more above the average level of the sea level.
Passivation	:	The elimination of all stored energy on a Space Object to reduce the chance of Break-up. Typical Passivation measures include venting or burning excess propellant, discharging batteries and relieving pressure vessels.
Protected Regions	:	Regions with a unique nature recognized by best international practices and standards, which are protected from the generation of Space Debris to ensure their safe and sustainable use. Those regions are: a. Low Earth Orbit (LEO) Region: spherical region that extends from the Earth's surface up to an altitude (Z) of 2,000 km. b. Geosynchronous Region (GSO): a segment of the spherical shell defined by the following: • Lower altitude = geostationary altitude minus 200 km • Upper altitude = Geostationary altitude plus 200 km

- 15 degrees ≤ latitude ≤ +15 degrees.
- Geostationary altitude (ZGEO) = 35,786 km (the altitude of the Geostationary Earth Orbit).

Re-Entry	:	The process of returning or attempting to return a Space Object from the Identified Area, including all necessary stages and preparations for Re-entry into the Earth's atmosphere, until the Space Object has come to a rest on the earth surface.
Re-Orbit	:	Intentional changing of a Space Object's orbit.
Space Debris	:	A space object, or a part thereof, that no longer has a role or any purpose, including its parts or components and the resulting materials, wastes or fragments, whether in outer space, including the earth's orbit or within the earth's atmosphere.
Space Object	:	Man-made object Launched or intended to be Launched into or out of the Identified Area, whether manned or un-manned, including its components as well as its launch vehicle, and parts thereof, including those not reaching the Identified Area.
Person	:	Natural or legal person.
Preventive Measures	:	Any activity which reduces the potential for producing space debris or minimising the risk of producing space debris.

Section (2)

Purpose

The purpose of The Guidelines is to:

1- Encourage the reduction of creating new Space Debris in Identified Area by providing recommendations to Operators conducting Space Activities that will be authorized in accordance with the Authorization Regulation and fostering the adoption of design solutions for Space Objects minimizing the risk of generating new Space Debris as well as encouraging the adoption of standards and best practices limiting the production of Space Debris during the operational, and Disposal Phase.

2- Ensure the protection of the State's national interests in terms of liability, national security, and safety; in addition to ensure the conformity of the State with its international commitments, international law, and international standards and best practices.

3- Promote the long term sustainability of Outer Space for peaceful purposes and the benefit of Mankind.
4- Ensure compliance of Operator with its obligations arising from The Law and its Regulations, related to reporting and to the Space Debris Mitigation Plan as proposed in section (7) of The Guidelines.

Section (3)

Scope and Applicability

1- These Guidelines are applicable:
(a) To all Space Activities and other activities related to the space sector falling within the scope of the Law and Regulations adopted thereunder.
(b) To all Space Objects (including any components attributable to such Space Objects) authorized and or registered in the State's national registry of Space Objects.
(c) To all Space Objects orbiting or intended to orbit the Earth, in particular in or through Protected Regions, and/or Space Objects authorized, and/or registered in the State's national registry of Space Objects and/or where the State is a Launching State.

2- These Guidelines will operate in conjunction with the Law and all other applicable regulations as issued by the Agency from time to time.

3- The Guidelines provide measures based on underscored standards and best practices as, which can be considered during each phase of the life cycle of the Space Object, including Launch, operations and Disposal Phase.

4- The underscored standards and best practices in The Guidelines can be implemented during the design and operation of Space Objects registered by or in the UAE. Moreover, they are implemented throughout the conduct of Space Activities with the intention to minimize the creation of Space Debris.

5- The Guidelines detail measures that are recommended be The Agency to be applied by the Operator, and that will be subject to the Authorization Regulatory Framework, as follows:

(a) Measures described in Section (4) of The Guidelines set obligations for Operators to submit Reports and Plans to the Agency, in which are considered a requirement to obtain an authorization.
(b) Measures described in Section (7) of The Guidelines are not mandatory but strongly recommended to be adopted by the Operator, and are not considered a requirement to obtain an authorization by the Agency.

6- Operators shall take all reasonable measures to minimize risk of collision between a Launch Vehicle, including its component parts, and any other Space Object.

7- Operators who apply The Guidelines will receive, upon request, documentary evidence by the Agency related to registration of the Operator's Space Object in the UAE national registry, as may be required by the Operators in support of obtaining landing rights or other authorizations with other countries.

Section (4)

Space Debris Mitigation Plan and Required Reports

1- An Operator or an applicant, shall submit a Space Debris Mitigation Plan as part of the procedure for obtaining or renewing, an Authorization pursuant to the Authorization Regulation. The Space Debris Mitigation Plan should take into account international standards and best practices and in particular the following:
   (a) ISO 24113:2011: Space systems - Space Debris Mitigation Requirements and any other ISO standards applicable to Space Debris which may be in effect from time to time;
   (b) IADC Guidelines; Inter-Agency Space Debris Coordination Committee (IADC) Space Debris Mitigation Guidelines,
   (c) Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space from the United Nations (UN COPUOS).

2- The Space Debris Mitigation Plan shall be updated by the Operator as required and any amendment shall be submitted to the Agency as soon as possible.

3- The Space Debris Mitigation plan shall consist of the following elements:
   (a) Risk assessment as described in Section (5).
   (b) The implementation plan as described in section (6) and all related procedures developed by the Space Object Operator.

4- Operators shall provide the Agency with the following reports:
   (a) A Pre-Launch Report, including information about the Launch Vehicle, Launch, Launch territory, Space Object, Space Object's manufacturer, the owner of the Space Object, Operator, as well as information on the orbital parameters and any other information as reasonably requested by the Agency.
   (b) A Post-Launch Report, including a description of the outcome of the Launch performed.
   (c) A Post-mission Report including a description of the end-of-life maneuvers of a Space Object and the measures taken for its Disposal.

5- Operator shall notify the Agency immediately in any of the following cases:
   (a) The end of the functional use of a Space Object, its disposal or Re-Entry.

(b) In case of any Accident or Incident involving the Space Object.
(c) The emergence of Space Debris from a Space Objects.
(d) If a Space Objects is exposed to any high risk including, without limitation, loss of control, or collision with Space Debris or other Space Objects in Identified Area.

6- In case of a controlled Re-entry of a Space Object, the Operator shall inform the Agency of the Re-Entry time and trajectory and the associated ground area. In case of an uncontrolled Re-Entry, the Operator shall notify the Agency and provide all necessary information and data on such Re-Entry, to its best endeavors.
7- Operators shall provide yearly reports about the status of the authorized activities, within the required reports in accordance of the Authorization Regulation
8- If the measures and best practices of The Guidelines are not applied, or not applicable, the Operator shall provide an explanation and any supporting evidence to the Agency. In such case, Operator shall provide alternative measures which have been taken to reduce the Space Debris risk. Any alternative measures adopted shall only be acceptable to the Agency provided that such measures take into account the best international practices in the field of space debris mitigation.
9- The Agency after reviewing the Space Debris Mitigation Plan and submitted reports and notifications, may recommend the Operator to submit more documents or clarifications. It also may direct or recommend the Operator to modify the plan or update the submitted reports.

Section (5)

Risk Assessment

1- Each Operator is encouraged to take into account the aim to avoid or mitigate Space Debris throughout all phases of the activities, including Design and Manufacturing phase.
2- Based on the Space Debris Mitigation Plan, Operator shall conduct detailed risk evaluations concerning the creation of Space Debris and shall adopt appropriate measures for its avoidance or mitigation.
3- The below recommendation encourages Operators to provide detailed risk evaluations in three phases:
(a) During the Design and Manufacturing Phase:
During the Design and Manufacturing Phase, measures should be considered to avoid or reduce the potential of generating Space Debris during Nominal Operations, during Special Operations (e.g. malfunctions or safe mode, change of orbit), or after orbital collisions, or due to Accidental explosion or destruction to the maximum extent possible.

(b) During the Mission Phase:

(b.1) During the Mission Phase, measures should be considered to avoid, reduce or mitigate the generation of Space Debris, including conducting proper collision avoidance, end-of-life, Disposal or Re-Entry manoeuvres. In case of activities that include the release of objects in orbit, measures should be taken to avoid or reduce any adverse effects on the space environment and any risks to Space Objects.

(b.2) For all propulsion systems, an assessment should be made to ensure that they will not release propellant or other materials in orbit.

(c) During the end of life, disposal and Re-Entry phase:

(c.1) The assessment should demonstrate that the Space Object minimizes the risk of Break-up or release of Space Debris during end-of-life, disposal or Re-Entry phase.

(c.2) In particular, for Space Object passing through Protected Regions during disposal or Re-Entry, the assessment should demonstrate that the Space Object minimizes the risks to other Space Objects.

Section (6)

Implementation Plan

1- Operator shall set up an implementation plan based on the risk assessment. The Implementation Plan should contain a clear detailed description of all procedures will be placed to avoid or mitigate Space Debris and limits its effects.
2- Operator is encouraged to take into account, when developing the implementation plan referred to in the above paragraph, best international standards or practices, whether referred to in this Guideline or internationally known, or other, or the recommendations mentioned in section (8) of this Guideline regarding prevention of in-orbit breakups measures, disposal measures and on-orbit collision avoidance measures.
3- In the event where the standard or best practices or any other standers, or the recommendations referred to in the above paragraph, is not applied; operator shall provide a practical and convincing explanation or a justification. In such case, the matter will be studied by the Agency who will direct or recommend the operator to take specific action that will improve the operator's current status. Therefore, the Operator may be granted the

Authorization with mentioning the required conditions, if any, or denied the Authorization with explaining the reasons.

4- Each Operator shall assign a responsible employee with an appropriate authority or a delegation to follow up with the implementation of the Space Debris Mitigation Plan and the related procedures and measures, and provide the Agency with his contact details.

Section (7)

Best Practices for Prevention of In-Orbit Break-ups, Disposal and On-Orbit Collision Avoidance Measures.

This section provides recommendations to Operator for prevention of in-orbit breakups, its disposal and on-orbit collision avoidance measures as part of the Implementation measures. The Operator is encouraged to use these Guidelines to assess its compatibility with the measures mentioned therein.

1- Measures for the Prevention of In-orbit Break-ups During Nominal Operations as well Upon End of Life

The Implementation plan should describe the procedures taken by the Operator to constantly monitor the Space Object during Nominal Operations in order to detect malfunctions that could lead to a Break-up or a loss of control. The plan should also include the adequate recovery measures or the measures to passivate and dispose the Space Object in case recovery measures cannot be performed or are not successful.

2- Measures for Space Object Disposal

(a) The Implementation plan should include all the Passivation measures taken by the Operator to passivate the Space Object in order to minimise the risks of in-orbit Break-ups after the end of life and/or disposal of the Space Object.

(b) The plan for end of life and/disposal should include the planned Graveyard Orbit or the fulfilment of the 25 years orbital life limit as per the international standards and best practices.

(c) Operator should consider that:

(c.1) GEO Space Object being inserted into Graveyard Orbit should perform a minimum increase in perigee altitude of:

235km + (1000•CR•A/m); where:

- CR: is the solar radiation pressure coefficient.

- A/m: is the aspect area to dry mass ratio (m2 kg-1).

- 235 km: is the sum of the upper altitude of the GEO protected region (200 km) and the maximum descent of a re-orbited spacecraft due to luni-solar & geopotential perturbations (35 km). C.2. An eccentricity less than or equal to 0.003.

(d) Operator can also, follow other options or options described in the "Support to the Inter-Agency Space Debris Coordination Committee (IADC) Space Debris Mitigation Guidelines".

(e) For Space Objects passing through the LEO region, the plan should show the measures taken to ensure that the time needed for the Space Object to Re-Entry Earth as per existing international standards and best practices.

(f) If a Space Object is to be disposed by Re-Entry into the atmosphere, the plan should show that the Space Debris that reaches the surface of the Earth, should not pose risk to people or property.

(g) For highly utilized orbit regions, the plan should include the procedures put in place to reduce the presence in such orbit regions after end-of-life and for potential orbital relocation.

3- Measures for On-orbit Collision Avoidance:

(a) For orbital Launch Vehicles:

In order to reduce the risk of collisions between a Launch Vehicle, including its component parts and a Space Object, by all reasonable means, Operator should ensure that a Launch Vehicle and its component parts do not approach closer than 200 km to a Space Object for which the orbital parameters are known and available. The Operator should do the following in his plans:

(a.1) Gain data from space surveillance and tracking service providers; e.g. US Joint Space Operations Center "CSPOC",

(a.2) Exchange information about the planned Launch trajectory, perform pre-Launch conjunction assessments as deemed necessary and as appropriate with concerned entities (e.g. directly or through service providers),

(a.3) Implement collision avoidance strategies; e.g. adjustment of Launch time.

(b) For Space Object that can perform collision avoidance maneuvers: Operator should indicate its plans to:

(b.1) Gain data from space surveillance and tracking service providers (e.g. US "CSPOC"),

(b.2) Exchange orbital parameters of the spacecraft as deemed necessary and as appropriate with concerned entities (e.g. with SST service providers and/or dedicated satellite Operators associations),

(b.3) Perform conjunction assessments (directly or through service providers) and,

(b.4) Implement collision avoidance strategies (probabilistic or geometric approach) for performing collision avoidance maneuvers.

(c) For Space Objects that cannot perform collision avoidance maneuvers:

The Implementation plan should adopt satellite design solutions that enhance the in-orbit track ability of the Space Object by space surveillance and tracking systems (e.g. ground radars, telescopes) and/or include on-board technology (e.g. GPS receiver) to determine their in-orbit position accurately. The plan should also indicates how to share orbital position parameters with space surveillance and tracking service providers (e.g.US CSPOC) and/or dedicated satellite Operators associations to enhance reliability of conjunction assessments.

(d) For Space Objects in GEO and LEO satellite constellations: The plan should include inclination and eccentricity vector separation strategies to maintain objects at safe distances.

(e) The Implementation plan may include adoption of debris protection means for Space Objects (e.g. shielding) against small debris. However, it is not a requirement because these means are still in a study/RTD phase.

(f) Further information on practices for the prevention of in-orbit collisions can be found in the "Support to the IADC Space Debris Mitigation Guidelines" document as well as in the relevant ISO TR – technical reports.

Section (8)

Rendezvous and Proximity Operations for Space Object Maintenance or Disposal

1- If the Operator intends to employ rendezvous and proximity operations (RPO) to maintain or dispose of a space object, he shall notify the Agency and provide the Agency with a space debris mitigation plan.

2- An Operator intending to employ RPO to maintain or dispose of a space object must receive an Authorization from The Agency. An entity proposing to provide RPO to the Operator must

receive Authorization to perform RPO from the Agency running concurrent with the Authorization of the Operator.

Section (9)

Monitoring and Review

1- The Agency will follow up with the implementation and the updates of the space debris mitigation plan by of the Operator, through yearly reports.
2- The Agency will review and update The Guidelines from time to time, which may be appropriate for assessing the development of international standards and best practices, and the experiences and experiments of conducting space activities in the State.
3- The Agency may ask the operator to provide any other measures regarding the space debris mitigation plan, based on its assessment for the space activity nature, and the Operator shall provide it with such measures.

Issued on 23 August 2022

H.E. Sarah Bint Yousif Al Amiri

Chairwoman of the UAE Space Agency

Minister of State for Public Education and Advanced Technology