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Long-term sustainability of outer space activities

Proposal for a draft report and a preliminary set of draft guidelines of the Working Group on the Long-term Sustainability of Outer Space Activities

Working paper by the Chair of the Working Group

I. The context of guidelines for the long-term sustainability of outer space activities

Background

1. In *The Space Millennium: Vienna Declaration on Space and Human Development*,¹ the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space recognized the importance of space science and space applications for improving our fundamental knowledge of the universe, and for improving the daily lives of people worldwide through environmental monitoring, management of natural resources, early warning systems to help mitigate potential disasters and support disaster management, meteorological forecasting, climate modelling, satellite navigation and communications. Space science and technology make a major contribution to the well-being of humanity and, specifically, to achieving the objectives of global conferences of the United Nations that address various aspects of economic, social and cultural development. Space activities therefore play a vital role in supporting sustainable development on Earth and the

* A/AC.105/C.1/L.332.

¹ *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.



achievement of the Millennium Development Goals, and in contributing to the post-2015 development agenda process. Hence, the long-term sustainability of space activities is a matter of interest and importance not only for current and aspiring participants in space activities, but also for the international community as a whole.

2. The space environment is being used by more and more States, international intergovernmental organizations, non-governmental organizations and private sector entities. The proliferation of space debris and the increased possibilities of collisions and interference with the operation of space objects raise concerns about the long-term sustainability of space activities, particularly in the low Earth orbit and geostationary orbit environments.

3. The Committee on the Peaceful Uses of Outer Space, through its work in different fields, has a significant role to play in examining and enhancing the long-term sustainability of outer space activities in all its aspects. In addition to the existing United Nations treaties and principles on outer space, in 2007 the Committee adopted a set of voluntary high-level guidelines for the mitigation of space debris (ST/SPACE/49) and in 2009 it developed, jointly with the International Atomic Energy Agency, a high-level safety framework for nuclear power source applications in outer space (A/AC.105/934).

4. In accordance with General Assembly resolution 64/86, the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, at its forty-seventh session, in 2010, established a working group on the agenda item entitled “Long-term sustainability of outer space activities”.

5. The Working Group on the Long-term Sustainability of Outer Space Activities conducted its work in accordance with the terms of reference and methods of work endorsed by the Committee on the Peaceful Uses of Outer Space at its fifty-fourth session, in 2011 (A/66/20, annex II). Four expert groups were established to consider the following sets of closely related topics:

(a) Sustainable space utilization supporting sustainable development on Earth (expert group A);

(b) Space debris, space operations and tools to support collaborative space situational awareness (expert group B);

(c) Space weather (expert group C);

(d) Regulatory regimes and guidance for actors in the space arena (expert group D).

6. The present report contains a proposal for a draft report of the Working Group on the Long-term Sustainability of Outer Space Activities and a preliminary set of draft guidelines on the long-term sustainability of outer space activities. Included in this proposal is information on the context for the guidelines to promote long-term sustainability of outer space activities, their background, purpose, rationale, scope and application, as well as their implementation and updating. Also included are topics recommended for future consideration. The document has been developed in consultation with the co-chairs of the four expert groups and takes into consideration the findings of the expert groups, information provided by member States and international intergovernmental and non-governmental organizations, and information provided by national non-governmental organizations and private sector

entities, as obtained through States members of the Committee, as well as discussions held in the Working Group.

Purpose

7. The purpose of the present working paper is to identify areas of concern for the long-term sustainability of outer space activities and provide guidance to States, international organizations, national and international non-governmental organizations and private sector entities by proposing measures that could enhance sustainability in all its aspects, including the safe and sustainable use of outer space for peaceful purposes, for the benefit of all countries.

8. The proposed measures, compiled in a set of voluntary guidelines, provide a foundation for the development of national and international practices and safety frameworks for conducting outer space activities, while allowing for flexibility in adapting such frameworks to specific national circumstances and organizational structures. The guidelines address the policy, regulatory, scientific, technical and management aspects of space activities.

9. In the terms of reference and methods of work of the Working Group, it was agreed that the guidelines should:

(a) Create a framework for the possible development and enhancement of national and international practices pertaining to enhancing the long-term sustainability of outer space activities, including, inter alia, the improvement of the safety of space operations and the protection of the space environment, giving consideration to acceptable and reasonable financial and other connotations and taking into account the needs and interests of developing countries;

(b) Be consistent with existing international legal frameworks for outer space activities, be voluntary and not be legally binding;

(c) Be consistent with the relevant activities and recommendations of the Committee and its Subcommittees, as well as of other working groups thereof, United Nations intergovernmental organizations and bodies, the Inter-Agency Space Debris Coordination Committee and other relevant international organizations, taking into account their status and competence.

10. The guidelines contained in the present paper reflect an international consensus on measures needed to enhance the long-term sustainability of outer space activities, based on current knowledge and established practices. As a deeper understanding of the multifaceted nature of the issues develops, the guidelines should be reviewed and could be revised in the light of new findings.

Rationale

11. States, international organizations, national and international non-governmental organizations and private sector entities that are involved in space activities should take steps to ensure that their activities do not diminish the ability of others to carry out their own space activities, either now or in the future.

12. Over the years, different aspects of the long-term sustainability of outer space activities have been considered from various perspectives. The guidelines contained in this paper build on those previous efforts, with a view to providing a holistic approach to promoting the long-term sustainability of outer space activities.

13. The legal framework in which the set of guidelines contained in this paper was developed consists of the existing United Nations treaties and principles on outer space. In addition, current practices, operating procedures, technical standards and policies established and experiences gained through the conduct of space activities have also been taken into consideration in the compilation of the set of guidelines.

14. The guidelines are intended to be applied on a voluntary basis by States, either individually or collectively, international organizations, national and international non-governmental organizations and private sector entities to reduce the risks to the long-term sustainability of outer space activities for all participants in those activities and to ensure that all countries are able to have equitable access to outer space and the resources and benefits associated with it.

15. Since national and international frameworks for space activities should address policy, regulatory, scientific and technical and management aspects of mitigating risks to the safety and long-term sustainability of outer space activities, the guidelines have been grouped in corresponding categories to facilitate their implementation. The implementation of national and international frameworks for space activities not only provides assurance to users of the space environment, but also facilitates bilateral and multilateral cooperation in the peaceful uses of outer space and thereby contributes to the safety and stability of outer space.

Scope and application

16. The guidelines contained in this paper are applicable to all space activities, whether planned or ongoing, and all phases of a mission life cycle, including launch, operation and end-of-life disposal. The guidelines relate to policy, regulatory, scientific and technical, and management aspects of the safe and sustainable conduct of outer space activities, and are based on a substantial body of knowledge and the experiences of States, international organizations, national and international non-governmental organizations and private sector entities. Therefore, the guidelines are relevant to both governmental and non-governmental entities.

17. The guidelines are voluntary and not legally binding under international law. They are intended to supplement guidance available in existing standards and regulatory requirements.

18. The implementation of the guidelines is considered a prudent and necessary step towards preserving the outer space environment for future generations. States, international organizations, national and international non-governmental organizations and private sector entities should voluntarily take measures, through their own applicable mechanisms, to ensure that the guidelines are implemented, to the greatest extent feasible and practicable.

II. Guidelines for the long-term sustainability of outer space activities

19. The guidelines are grouped into five categories to facilitate their implementation by various governmental and non-governmental space actors: policy, regulatory mechanisms, international cooperation, scientific and technical, and management. The guidelines have been assigned numbers from 1 to 33 to facilitate their identification in upcoming discussions. The numbering in parentheses after each guideline refers to their numbering as contained in document A/AC.105/1041/Rev.1.

Policy

20. Guidelines 1 to 8 provide guidance on the development of policies and practices that support the long-term sustainability of outer space activities for Governments and relevant international intergovernmental organizations authorizing or conducting space activities. This guidance includes measures to facilitate the sharing of information and expertise on the conduct of space activities and measures to encourage research and development and other relevant activities by governmental and non-governmental entities to promote the long-term sustainability of outer space activities.

Guideline 1

Share experience and expertise relating to the long-term sustainability of outer space activities (D.2)

The experience and expertise acquired by those engaged in space activities are instrumental to the development of effective measures to enhance the long-term sustainability of outer space. Sharing such experience and expertise with others will facilitate and enhance the development of guidelines, rules, regulations and best practices in this area. The exchange need not be limited to State-to-State level, but can occur between national regulatory authorities, government agencies, [international] intergovernmental organizations and non-governmental entities. New participants and those with very little experience in space exploration will benefit from the experience and expertise of other space actors, and established actors will also find value in developing new partnerships and sharing experiences more widely.

Guideline 2

Develop and adopt procedures to facilitate the compilation and effective dissemination of information that will enhance the long-term sustainability of space activities, among the relevant space actors (D.3)

In many cases where States and international organizations are willing to share information, the procedures to enable information to be shared are non-existent or slow, or lead to incompatible data. The information should be shared as widely as necessary to enhance the long-term sustainability of outer space activities, which means adopting procedures that permit sharing with private sector entities and

national non-governmental organizations, in addition to sharing between States and international organizations. In some cases, private sector entities already have effective data-sharing mechanisms that States and other organizations might adopt. Ratification of and compliance with the Convention on Registration of Objects Launched into Outer Space should be encouraged as a starting point in the compilation and exchange of information.

Guideline 3

Promote the development of studies and other initiatives for the sustainable use of outer space, including celestial bodies (A.6)

In the peaceful use and exploration of outer space, including celestial bodies, States should take into account, with reference to the outcome document of the United Nations Conference on Sustainable Development, the three dimensions of sustainable development on Earth: social, economic and environmental.

States should consider adequate safety measures to protect the Earth and the space environment from harmful contamination, taking advantage of existing measures, such as best practices and guidelines that may apply to those activities, and developing new measures as appropriate.

Guideline 4

Promote, in accordance with the Radio Regulations and recommendations of the International Telecommunication Union, that Member States consider, in their use of the electromagnetic spectrum, the requirements of Earth observation systems and space-based services (A.1)

In their use of the electromagnetic spectrum, States should consider the requirements for space-based Earth observation systems and other space-based systems and services in support of sustainable development on Earth, in accordance with the International Telecommunication Union (ITU) Radio Regulations and recommendations.

Guideline 5

Promote and support research into and the development of sustainable space technologies, processes and services (A.7)

States and international organizations need to encourage the promotion of the development of technologies that minimize the environmental impact of manufacturing and launching space assets to enhance the long-term sustainability of those activities.

States and international organizations need to promote the development of technologies that maximize the reusability or repurposing of space assets.

States and international organizations could promote the development of space assets that maximize the use of renewable resources.

Guideline 6**Provide registration information to assist in the identification of space objects (B.8)**

States and international intergovernmental organizations should provide registration information on space objects in accordance with the Registration Convention and consider furnishing enhanced registration information, as recommended by the General Assembly in its resolution 62/101. States should provide that registration information to the Secretary-General of the United Nations as soon as practicable to assist in the identification of space objects and to contribute to the peaceful exploration and use of outer space.

Guideline 7**Promote institutional and public awareness of space activities and applications for sustainable development on Earth, disaster risk reduction, early warning of potential disasters, disaster management and disaster relief (A.2)**

States and international organizations should initiate the voluntary collection of information on public awareness and education tools and programmes aimed at disseminating information on the benefits of space for sustainable development and request the assistance of communications experts from States and the Office for Outer Space Affairs of the United Nations Secretariat to help in the preparation of a living repository of such information, with a view to facilitating the development and implementation of similar initiatives with consistent messages.

Space actors, including States and international organizations, should promote public awareness of space applications for sustainable development through a joint effort by public institutions, private sector entities and civil society, in particular taking into account the needs of young people and future generations.

In designing space education programmes, States and international organizations should pay special attention to courses on enhancing knowledge of and practice on the utilization of space applications to achieve sustainable development.

In accordance with the Principles Relating to Remote Sensing of the Earth from Outer Space (General Assembly resolution 41/65, annex) and in response to emergency situations that may affect fundamental social well-being, such as natural disasters and other major harmful incidents and catastrophes, States and international organizations should undertake efforts to make relevant space-based information and data accessible to affected countries, applying the principles of neutrality, impartiality and non-discrimination.

Guideline 8**Encourage and promote activities of non-governmental entities that will enhance the long-term sustainability of outer space activities, such as engaging stakeholders, developing consensus standards and common practices and increasing international cooperation (D.5)**

Non-governmental organizations and private sector entities conduct activities that have significant impacts, both directly and indirectly, on the long-term

sustainability of space activities. Private commercial activities in space are a growing part of the global economy, and many entities have taken steps to implement technical measures in conformity with the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space. Universities and other educational institutions have shown increasing interest in using small satellites for scientific and teaching purposes. Given the technical and cost constraints often associated with small-satellite missions, particular attention to the activities of non-governmental and private sector entities may be warranted to ensure that their activities do not become a significant source of long-lived orbital debris in the future.

Non-governmental organizations play important roles in bringing potential stakeholders together to develop consensus approaches to the conduct of space activities. For example, the International Organization for Standardization has adopted several standards on best practices and data-exchange formats for collision avoidance. States are encouraged to evaluate those standards and seek to use common standards, where practicable, for debris mitigation, orbit lifetime estimates, safe disposal of hardware, re-entry management and satellite characteristics and trajectories. This will, in turn, promote valuable contributions by non-governmental organizations in this field.

Non-governmental organizations, such as industry associations, academic institutions and educational public interest entities, can play important roles in increasing international awareness of issues associated with space sustainability, as well as practical measures to enhance sustainability. Such measures could include adoption of the Space Debris Mitigation Guidelines of the Committee, compliance with ITU Radio Regulations related to space services and the development of open, transparent standards for the exchange of data necessary to avoid collisions, radio frequency interference or other harmful events. To these ends, international cooperation between Governments and non-governmental organizations and private sector entities should be encouraged and fostered.

Regulatory mechanisms

21. Guidelines 9 to 15 provide guidance on the development of regulatory frameworks and practices that support the long-term sustainability of outer space activities for Governments and relevant international intergovernmental organizations authorizing or conducting space activities. The guidance addresses the adoption of national regulatory frameworks and the promotion of recommended voluntary measures to promote the safety and sustainability of outer space activities.

Guideline 9

Adopt national regulatory frameworks suitable for space activities that provide clear guidance to actors under the jurisdiction and control of each State (D.10)

With the globalization and generalization of space activities, in particular the emergence of new actors in non-governmental services and operations, States should adopt regulatory frameworks to ensure the effective application of international norms, considering the specificities of non-governmental entities for

which States bear international responsibility. States are encouraged to consider the application of relevant, generally accepted standards and best practices.

States are particularly encouraged to consider not only existing space projects and activities but also the potential development of their national space sector, and to envisage appropriate timely regulation in order to avoid legal lacunae. It is important that national regulation address the specific nature and characteristics of the State's space sector, as well as its general economic framework, which provides the context in which the space sector may further expand.

Guideline 10

Encourage advisory input from affected national stakeholders in the process of developing, refining and implementing national regulatory frameworks governing space activities (D.8)

States may find it beneficial and efficient to receive advisory input from affected national stakeholders during the process of developing regulatory frameworks governing space activities. The stakeholders may include private sector entities, universities, research organizations, non-governmental organizations operating under the jurisdiction of the State, agencies of the State or other bodies that play a role in space activities and that will be affected by the proposed regulatory initiative.

For a State with advanced space capabilities, stakeholders are likely to have a practical understanding of how a regulatory framework affects or will affect the operations or administration of the space activities. By allowing early advisory input, the State can avoid unintended consequences of regulation that have an adverse impact on key stakeholders. Those stakeholders might also be aware of conflicting obligations by law or agreement. Identifying such conflicts early can avoid jurisdictional disputes after the regulatory framework is adopted.

States with developing space capabilities should identify the essential components of a national regulatory framework after advisory input from, or consultation with, relevant stakeholders. Without such input, the State might regulate its stakeholders too heavily by writing a regulatory framework that is more restrictive than is needed. In instances in which the State has not previously attempted to legally control or regulate space activities, the State may wish to consider other States' space legislation or, by analogy, other national laws, as a guide to drafting. Without experience, however, the State might inadvertently write laws that are not applicable or not technically accurate for the particular space activities or space actors under its control.

In developing or refining national regulatory frameworks, all States should consider the need for appropriate transition periods and milestones for the implementation of measures to improve the long-term sustainability of space activities.

Guideline 11

Address risks to people, property, public health and the environment associated with the launch, in-orbit operation and re-entry of space objects in the development of national regulatory frameworks and international standards (D.11)

[Note: the supporting language for guideline D.11 is still under consideration by expert group D.]

Guideline 12

When adopting or implementing national regulatory frameworks, consider the long-term sustainability of outer space activities (D.6)

Traditionally, national regulation has been concerned with issues such as safety, liability, reliability and cost. As new regulations are developed, States should consider regulations that enhance the long-term sustainability of outer space activities. There are three major aspects to such regulation. The first is that States, in enacting new regulations, should bear in mind their obligations under article VI 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. The second is ensuring that space actors under the jurisdiction of the regulator are encouraged to conduct their activities in a manner that preserves the long-term sustainability of space activities. The third is the encouragement of appropriate new methods for ensuring the long-term sustainability of space activities. Regulation should not be so prescriptive as to prevent initiatives aimed at improving the long-term sustainability of space activities.

Guideline 13

Weigh the costs, benefits, disadvantages and risks of a range of alternatives in developing regulatory measures applicable to the long-term sustainability of outer space activities and consider the potential benefits of using existing international technical standards and definitions (D.9)

States should create and implement their own regulations, applicable to those persons subject to their jurisdiction or control as appropriate, and share such regulations and resulting experience with other States as models for consideration.

Regulations should be practicable, in that they should be capable of actually being implemented in terms of the technical, legal and management capacities of the State imposing the regulation. A closely related concept is that of technical feasibility, in that a regulation should not require a technical innovation or exceed the current state of practice for the space activity.

The effect of regulations should be predictable. The groups to which the regulation applies should know the effects of the regulation on their activities in advance of conducting those activities, as far as possible. A reporting regime to gather information on how the regulations are being applied in practice should be considered.

Regulations should be both efficient and effective. Effective regulations are those that accomplish their intended purpose. An important component of effective regulation is to ensure that the regulation has a clear intended purpose. At the same time, regulations need to be efficient in terms of imposing the least cost for compliance (e.g. in terms of money, time or risk) when compared with feasible alternatives. Compliance costs fall upon the regulator and the entity being regulated in both immediate and long-term effects. A best practice for controlling compliance costs is to ensure that regulations are performance-based and responsive to technical innovation. Their requiring a particular technical approach or proprietary solution that constrains future innovation should be avoided.

Guideline 14

Communicate within and among competent authorities to facilitate efficient and effective measures for the long-term sustainability of space activities (D.7)

States are encouraged to ensure that appropriate communication and consultation mechanisms are in place within and among the competent bodies that oversee or conduct space activities. This is because the regulation of space activities draws on many disciplines, such as economics, law, public policy and the social sciences, in addition to physical science and engineering, and no single entity can be expected to cover all disciplines. For example, licences imposing conditions on space operations may involve many distinct activities, such as launches, on-orbit operations, radio frequency usage, remote sensing activities and end-of-life disposal of space objects in orbit. Communication within and among relevant regulatory bodies can promote regulations that are consistent, predictable and transparent so as to ensure that regulatory outcomes are as intended.

Guideline 15

Conduct appropriately targeted outreach, capacity-building and education on regulations and best practices relevant to long-term sustainability in view of the increasing number and diversity of existing and potential space actors (D.4)

Appropriately targeted outreach and education can assist all space actors in gaining a better appreciation and understanding of the nature of their obligations, which can lead to improved compliance with the existing regulatory framework and the best practices currently being employed to enhance the long-term sustainability of outer space activities. While regulators should always strive for clarity when designing measures to enhance long-term sustainability, outreach and education can assist with any implementation issues that arise out of national regulatory frameworks. This is particularly valuable where the regulatory framework has been changed or updated, resulting in new obligations. States are encouraged to foster outreach activities by or with industry, academia, regulators and other relevant organizations.

States, including their regulators and agencies, can also benefit from the input of space actors when designing regulations and issuing guidelines to the space industry. Outreach programmes may provide a valuable, iterative feedback mechanism for regulators.

Outreach, capacity-building and educational initiatives could take the form of seminars (in person or broadcast over the Internet), published guidelines to

complement national or regional laws and regulations, an Internet site with basic information on a regulatory framework or the availability of a contact person within the Government who can assist participants in finding crucial information.

The availability of resources to support such initiatives varies greatly among States; thus, fostering similar initiatives by industry, academia and international organizations is strongly encouraged, as those entities can contribute valuable input on regulatory matters and best practices.

International cooperation

22. Guidelines 16 to 20 provide guidance on international cooperation measures aimed at promoting the long-term sustainability of outer space activities for Governments and relevant international intergovernmental organizations, authorizing or conducting space activities. The guidance includes measures to promote technical cooperation and capacity-building to improve the ability of developing countries to establish their own national capacities, in accordance with national legislation, multilateral commitments, non-proliferation norms and international law.

Guideline 16 [*still under discussion*]

[Promote and facilitate international cooperation in the peaceful uses of outer space as a means of enhancing the long-term sustainability of outer space activities] (D.1)

[Guideline 16 applies to all modes of cooperation, including governmental and non-governmental; commercial and scientific; global, multilateral, regional and bilateral; and among countries at all levels of development. This principle is particularly important since, for many States, international cooperation facilitates their participation in space exploration. Article IX of the Outer Space Treaty, when interpreted in the light of the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries, of 1996, bases international cooperation on the free determination of fair, equitable and mutually acceptable contractual terms.]

[*Text proposed by the United States to replace current guideline 16*]

[Guideline 16 applies to all modes of cooperation, including governmental and non-governmental; commercial and scientific; global, multilateral, regional and bilateral; and among countries at all levels of development. All States, particularly those with relevant space capabilities and with programmes for the exploration and use of outer space, should contribute to promoting and fostering international cooperation on the long-term sustainability of space activities on a mutually acceptable basis. In this context, particular attention should be given to the benefit for and interests of developing countries and countries with incipient space programmes stemming from such international cooperation conducted with countries with more advanced space capabilities. States are free to determine all aspects of participation in the exploration and use of outer space on a mutually

acceptable basis. The terms of such cooperative ventures, for example through contracts and other legally binding mechanisms, should be fair and reasonable.]

Guideline 17

Support and promote international cooperation for capacity-building and data accessibility, on a mutually acceptable basis, through the sharing of data, derived information and associated tools taking into account the needs and interests of developing countries (A.3)

States and international organizations should coordinate international cooperation efforts in space-related capacity-building and data accessibility in order to ensure efficiency in the use of available resources and, to the extent it is reasonable and relevant, avoid unnecessary duplication of functions and efforts, taking into account the needs and interests of developing countries.

States and international organizations should promote and support regional and international cooperation to assist countries in assembling human, technical and financial resources and to achieve efficient space-related capacities, enhancing the long-term sustainability of outer space activities and supporting sustainable development on Earth.

States and international organizations should explore new forms of regional and international collaboration, without prejudice to ongoing international collaboration initiatives, to assist countries in implementing at the national level space practices, standards and governance approaches, taking into account the need for the long-term sustainability of space activities and the needs and interests of developing countries.

Guideline 18

Promote international cooperation on a mutually acceptable basis, to support the growing interest of many countries in establishing national capacities for outer space activities through capacity-building and transfer of technology, without infringing intellectual property rights, and in accordance with non-proliferation norms and principles, taking into account the requirement of long-term sustainability of those activities (A.4)

States and international organizations should consider promoting international technical cooperation to enhance the long-term sustainability of outer space activities and support sustainable development on Earth.

States and international organizations should support current initiatives and consider new forms of regional and international collaboration to promote space capacity-building, taking into account the needs and interests of developing countries and in accordance with national legislation, multilateral commitments, non-proliferation norms and international law.

States and international organizations should promote technology safeguard arrangements that may facilitate space capacity-building, while respecting intellectual property rights, and in accordance with non-proliferation norms and principles, as well as the requirements for long-term sustainability.

States undertaking, authorizing or intending to undertake or authorize international space activities involving the use of goods (objects, materials, manufactured items, equipment and other products) that are based on technologies whose unauthorized disclosure and onward transfer are prohibited and thus warrant appropriate levels of protection should ensure that such activities are conducted in accordance with non-proliferation principles and the norms of international law, irrespective of whether such activities are carried out by governmental or non-governmental entities or through international organizations to which such States belong. Space activities should be in accordance with responsible standards and practices, such as subscription to and implementation of the Hague Code of Conduct against Ballistic Missile Proliferation.

States concerned should provide opportunities to establish stronger legal and administrative regulation relating to such cooperation in cases where it would be particularly appropriate or even essential in view of the nature of the controlled goods that are exported or imported. States should seek to forge collaborative relationships based on mutual benefits and equal advantages with regard to the consideration and resolution of issues relating to the coordination of procedures for safeguarding controlled products. To maximize the potential benefits of this practice, States are also encouraged to provide, by means of agreements or other arrangements, for the implementation of measures, institutionalized appropriately under their national legislation, to ensure the safety and security of imported controlled goods while they are in the territory of the importing State. In particular, States, acting in accordance with the relevant legislation and on a mutually accepted basis, should enter into consultations to reach agreement in relation to:

(a) Post-sale monitoring and verification to ascertain that controlled items are not at risk of unauthorized use or onward transfer;

(b) Strengthening end-use certification and authentication procedures at the State level;

(c) Providing legal supervision of contracts and contract-based activities in order to effectively facilitate the proper application of agreed measures on end use and to prevent any circumstances in which exported protected goods, when located in the territory of the importing State, could become the subject of disputed jurisdiction or be used for illegal purposes;

(d) Ensuring that the relevant State bodies have the power and capacity to monitor the end use of controlled items and to take immediate measures (including the issuance of the relevant orders) where there is a presumption of non-compliance with the arrangements on end use.

Guideline 19

Promote international cooperation to assist countries in gathering human resources and achieving technical and legal capabilities and standards compatible with the relevant regulatory frameworks, especially countries that are beginning to develop their capacities in outer space applications and activities (A.5)

States and international organizations should support current initiatives and promote new forms of regional and international cooperation to assist countries in

gathering human and financial resources and achieving efficient technical capabilities and standards for outer space activities, compatible with long-term sustainability and relevant regulatory frameworks, and to assist emerging space countries in implementing national space regulations, taking into account the need for the long-term sustainability of space activities.

Guideline 20

Provide appropriate contact information (B.6)

States and international organizations are encouraged to exchange contact information for appropriate entities responsible for spacecraft operations and conjunction assessment.

States and international organizations are also encouraged to establish appropriate procedures to enable timely coordination to reduce the probability of, and facilitate effective responses to, orbital collisions, orbital break-ups and other events that might increase the probability of accidental collisions.

Scientific and technical

23. Guidelines 21 to 31 provide guidance of a scientific and technical nature for Governments, international intergovernmental organizations, national and international non-governmental organizations and private sector entities that conduct space activities. They encompass, among other things, the collection, archiving, sharing and dissemination of information on space objects and space weather, and the use of standards for information exchange.

Guideline 21

Promote the collection, sharing and dissemination of space debris monitoring information (B.1)

States and international organizations should encourage the development and use of relevant technologies for the measurement, monitoring and characterization of the orbital and physical properties of space debris and should promote the sharing and dissemination of derived data products and methodologies for their use.

Guideline 22

Implement space debris mitigation measures (B.2)

In accordance with the Space Debris Mitigation Guidelines of the Committee, States and intergovernmental organizations should address, establish and implement space debris mitigation measures through applicable mechanisms.

Guideline 23

Limit the risk to people and property from controlled re-entries (B.3)

In cases of controlled re-entries of spacecraft or launch vehicle orbital and/or suborbital stages, States and international organizations should consider furnishing notices to aviators and mariners using already established procedures [and as appropriate, inform the public and other States].

Guideline 24 *[still under discussion]*

[Promote techniques to improve the accuracy of orbital data for the safety of on-orbit operations] (B.4)

[Recognizing that [the safety of] space operations depend[s] strongly upon the accuracy of orbital and other relevant data, States are encouraged to promote the investigation of methods to improve knowledge regarding orbits [and attitudes] of space objects. Those methods could include international cooperation and combining and validating data from different sources, including existing and new sensor capabilities and distribution mechanisms, as well as passive and active on-orbit tracking aids.]

Guideline 25

Perform conjunction assessment during orbital phases of controlled flight (B.5)

Conjunction assessment with other space objects should be performed for all spacecraft capable of adjusting trajectories during orbital phases of controlled flight for current and planned spacecraft trajectories.

Appropriate steps of the conjunction assessment process include improving the orbit determination of relevant space objects, screening current and planned trajectories of relevant space objects for potential collisions and determining whether an adjustment of trajectory is required to reduce the risk of collision, in coordination with other operators and/or organizations responsible for conjunction assessment, as appropriate.

States and international organizations are encouraged to develop and implement common approaches on conjunction assessment.

Guideline 26

Promote use of standards when sharing orbital information on space objects (B.7)

When sharing orbital information on space objects, operators and other appropriate entities should be encouraged to use common, internationally recognized standards to enable collaboration and information exchange. Facilitating greater shared awareness of the current and predicted location of space objects would enable timely prediction and prevention of potential collisions.

Guideline 27

Support and promote the collection, archiving, sharing, intercalibration and dissemination of critical space weather data (C.1)

States and international organizations should engage experts in identifying data sets critical for space weather services and research and adopt policies for the free and unrestricted sharing of critical space weather data from their space- and ground-based assets. All space actors and governmental, civilian and commercial space weather data owners are urged to allow free and unrestricted access to and archival of such data for mutual benefit.

States and international organizations should also share real-time and near-real-time critical space weather data and data products and should

cross-calibrate and intercalibrate critical space weather data and data products; openly share critical space weather data and data products in a common format; adopt common access protocols for their critical space weather data and data products; and promote the interoperability of space weather data portals, thus promoting ease of data access for users and researchers.

States and international organizations should further undertake a coordinated approach to maintaining long-term continuity of space weather observations, and identifying and filling key measurement gaps, so as to meet critical space weather needs. Space actors, including States and international organizations, are urged to fly small and low-power integrated payloads for space weather science and monitoring whenever and wherever possible (e.g. radiation monitors on Earth-orbiting satellite missions).

Guideline 28

Support and promote further coordinated development of advanced space weather models and forecasting tools in support of user needs (C.2)

States and international organizations should engage experts in developing a coordinated approach to documenting space weather research, user needs and operational models, as well as forecasting tools currently in use, and assess them in relation to space weather science and the needs of services and users.

States and international organizations should undertake a coordinated approach to identifying and filling gaps in research and operational models and forecasting tools required to meet the needs of space weather science and services and users. Where necessary, this should include coordinated efforts to support and promote research and development to further advance space weather models and forecasting tools.

Guideline 29

Support and promote the coordinated sharing and dissemination of space weather model outputs and forecasts (C.3)

States and international organizations should identify high-priority needs for space weather models, space weather model outputs and space weather forecasts and adopt policies for free and unrestricted sharing of space weather model outputs and forecasts. All governmental, civilian and commercial space weather model developers and forecast providers are urged to allow free and unrestricted access to and archival of space weather model outputs and forecasts for mutual benefit, which will promote research and development.

States and international organizations should also encourage their space weather service providers to undertake comparisons of space weather model and forecast outputs with the goal of assessing their metrics and comparative performance with the goal of improved model and forecast accuracy; openly share and disseminate historical and future critical space weather model outputs and forecast products in a common format; adopt common access protocols for their space weather model outputs and forecast products to the extent possible, to promote their ease of use by users and researchers, including through interoperability of space weather portals; and undertake coordinated dissemination

of space weather forecasts among space weather service providers and to operational end users.

Guideline 30

Support and promote the collection, sharing and dissemination of and access to information relating to best practices for mitigating the effects of space weather on terrestrial and space-based systems and related risk assessments (C.4)

States and international organizations are urged to submit, to a common archive, documentation outlining best design practices, guidelines and lessons learned relating to mitigation of the effects of space weather on operational systems, as well as documentation and reports relating to space weather user needs, measurement requirements, gap analyses, cost-benefit analyses and related space weather assessments.

States and international organizations should provide support to enable national agencies, satellite operators and space weather service providers to work towards the development of international standards and best practices applicable for the mitigation of space weather effects in satellite design.

States and international organizations should support and promote cooperation and coordination on ground- and space-based space weather observations, forecast modelling, satellite anomalies and reporting of space weather effects in order to safeguard space activities. This could be done in collaboration with the International Space Environment Service and the World Meteorological Organization (WMO).

States and international organizations should:

(a) Incorporate current, “nowcast” and forecast space weather thresholds into space launch commit criteria;

(b) Provide support to enable their satellite operators to work together with space weather service providers to identify the information that would be most useful to mitigate anomalies and to derive recommended specific guidelines for best practices for on-orbit operation. For example, if the radiation environment is hazardous, this might include actions to delay the uploading of software, action manoeuvres, etc.;

(c) Incorporate in satellite designs the capability to recover from a debilitating space weather effect, such as by including a safe mode;

(d) Incorporate space weather effects into satellite designs and mission planning for end-of-life disposal in order to ensure that the spacecraft either reach their intended graveyard orbit or de-orbit appropriately, in accordance with the Space Debris Mitigation Guidelines of the Committee. This should include appropriate margin analysis.

States and international organizations should also:

(a) Encourage the collection, collation and sharing of information relating to ground- and space-based space weather-related impacts and system anomalies, including spacecraft anomalies;

(b) Encourage the use of a common format for reporting the information. In relation to the reporting of spacecraft anomalies, the template of the Coordination Group for Meteorological Satellites provides an excellent proposed approach;

(c) Encourage policies promoting the sharing of satellite anomaly data such that the satellite anomaly archive is available to all States.

It is acknowledged that some data may be subject to legal restrictions and/or measures for the protection of proprietary or confidential information.

States should undertake an assessment of the risk and socioeconomic impacts of adverse space weather effects on the technological systems in their respective countries. The results from such studies should be published and made available to all States.

Guideline 31

Promote the education, training and capacity-building required for a sustainable global space weather capability (C.5)

Given that WMO already has extensive training programmes on terrestrial weather, expanding this activity to also include space weather training would be valuable, since it would leverage the existing infrastructure and capabilities.

States and international organizations should encourage space weather training in space weather workshops. Examples of training opportunities include the annual Space Weather Workshop in the United States of America, organized by the United States National Oceanic and Atmospheric Administration, the European Space Weather Week, the Asia-Oceania Space Weather Alliance workshops, the International Space Weather Initiative schools and the United Nations-affiliated regional centres on space science and technology education.

Management

24. Guidelines 32 and 33, proposed by the Chair of the Working Group, provide guidance for the management of entities conducting outer space activities. Such entities include governmental agencies, international intergovernmental organizations, non-governmental and private-sector entities, and academic and research institutions. In the first instance, management should ensure that the entity has the means to comply with the relevant national and international regulatory frameworks and mechanisms for conducting outer space activities. Additional management responsibilities should include establishing and fostering an organizational culture and appropriate systems to promote the long-term sustainability of outer space activities.

Guideline 32**Entities that conduct outer space activities should ensure that they have the means to comply with relevant governmental and intergovernmental regulatory frameworks, requirements, policies and processes that promote the long-term sustainability of outer space activities**

States bear international responsibility for national activities in outer space and for the authorization and continuing supervision of such activities, which are to be carried out in conformity with international law. However, the direct responsibility for ensuring that a given space activity does not jeopardize the long-term sustainability of outer space activities in general lies with the entity conducting that activity. In this regard, the management of that entity should take steps to:

- (a) Establish and maintain all the necessary technical competencies required to conduct outer space activities in a safe and responsible manner and to enable it to comply with the relevant governmental and intergovernmental regulatory frameworks, requirements, policies and processes;
- (b) Develop specific requirements and procedures to address the safety and reliability of outer space activities under the entity's control, during all phases of a mission life cycle;
- (c) Assess all risks to the long-term sustainability of outer space activities associated with the space activities conducted by the entity, in all phases of the mission life cycle, and take steps to mitigate such risks.

Guideline 33**Entities that conduct outer space activities should ensure that they have the appropriate systems and organizational culture in place to promote the long-term sustainability of outer space activities**

The management of an entity that conducts outer space activities should ensure that the entity's structures and procedures for planning and conducting space activities support the objective of promoting the long-term sustainability of outer space activities. Appropriate measures to be taken by management in this regard should include:

- (a) A commitment at the highest levels of the entity to promoting the long-term sustainability of outer space activities;
- (b) Establishing and fostering an organizational culture and commitment to promoting the long-term sustainability of outer space activities within the entity, as well as in relevant interactions with other entities;
- (c) Ensuring that the entity's commitment to the long-term sustainability of outer space activities is reflected in its management structure and procedures for planning, developing and conducting outer space activities;
- (d) Encouraging, as appropriate, the sharing of the experiences of the entity in the conduct of safe and sustainable outer space activities as a contribution by the entity to the promotion of long-term sustainability of outer space activities;
- (e) Designating a contact point within the entity responsible for communication with relevant authorities to facilitate efficient and timely sharing of

information and coordination of potentially urgent measures to promote the safety and sustainability of outer space activities.

III. Implementation and updating

Implementation

25. Without prejudice to the sovereign right of States to determine and establish their own control mechanisms for implementing their international obligations under existing treaties and principles governing the activities of States in the exploration and use of outer space, States are encouraged to implement the guidelines presented above to the greatest extent practicable and in accordance with their national law.

26. International cooperation is essential for promoting the long-term sustainability of outer space activities. Existing information-sharing mechanisms established by the United Nations treaties and principles on outer space, and further supplemented by the guidelines, provide a basis for collecting and exchanging information, knowledge and experience with respect to the progress being made in the protection of the outer space environment. States are encouraged to provide information on their experiences of implementing the guidelines to the Committee on the Peaceful Uses of Outer Space on a regular basis.

Updates

27. The guidelines presented above are based on the substantial body of knowledge that exists for conducting space activities in a safe and sustainable manner. However, the development of the guidelines has also revealed areas where the scientific and technical data or experience required to provide a sound basis for recommending a guideline do not yet exist. Research by States and international organizations on the sustainable use of outer space and on the development of sustainable space technologies, processes and services should continue, as recommended in the guidelines, in order to address those open questions. As the conduct of space activities evolves, which it is doing rapidly, and as more knowledge is gained, the guidelines should be reviewed and revised periodically to ensure that they continue to provide effective guidance to States and to all space actors to promote the long-term sustainability of outer space activities.

IV. Recommended topics for future consideration

28. During the discussions in the expert groups, a number of topics were identified for future consideration. Those topics are, as identified by the expert groups, presented in the following paragraphs for consideration by the Working Group.

29. The Committee on the Peaceful Uses of Outer Space should consider examining the issue of the exploitation of natural resources in outer space in the context of sustainable development.

30. States and international organizations should compile a compendium of measures, practices, standards and other elements conducive to the safe conduct of

space activities, including the sustainable exploitation of natural resources in outer space. The compendium should be made freely available and promoted by all space actors, including States and international organizations.

31. The Committee should work towards the development of initiatives for space benefits and for equitable, efficient and rational access to space to support sustainable development on Earth.

32. States are encouraged to develop new standards for the avoidance of harmful contamination of outer space to promote the long-term sustainability of outer space, including celestial bodies.

33. States members of the Committee should consider the scientific, technical and legal questions arising from active removal of space debris.

34. States members of the Committee should work through the Committee, under the space weather agenda item of the Scientific and Technical Subcommittee, and through related international organizations to develop a basis and provide a mechanism for the coordination of ground- and space-based research and operational infrastructure to ensure the long-term continuity of critical space weather observations.

35. States and international organizations should investigate the coordination of space weather information, including observations, analyses and forecasts, to support decision-making and risk mitigation relating to the operation of satellites, spacecraft and suborbital vehicles, including rockets and vehicles serving manned spaceflight, including for space tourism.

36. States members of the Committee should work towards:

(a) Developing definitions of terms related to a number of key issues affecting the long-term sustainability of outer space activities;

(b) Developing regulations relating to the ownership of space objects;

(c) Enhancing the practice of States and international intergovernmental organizations in registering space objects, as recommended by the General Assembly in its resolution 62/101 of 17 December 2007;

(d) Improving consistency in the practice of States concerning licensing, registration fees and insurance requirements.

37. States members of the Committee should work through the Scientific and Technical Subcommittee to implement a process to evaluate the impact and review the progress of the implementation of the guidelines on the long-term sustainability of outer space activities, and to update the guidelines, if deemed necessary.