Control over activities harmful to the environment

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Control of space debris

The amount of orbital debris resulting from human exploration and use of outer space has been steadily increasing in the history of human exploration and use of outer space. Major break-up incidents have resulted in a dramatic increase of space debris. The United States (US) Space Surveillance Network (SSN) currently tracks around 23,000 pieces of debris larger than 10 cm. Those pieces of debris, which travel at very high speed, are one of the primary threats to spacecraft and human space missions.

Law of outer space and international environmental law

The term “space debris” cannot be found in any of the five United Nations (UN) outer space treaties or in any legally binding treaties aimed at protecting the environment. Nevertheless, this does not mean that space debris remain largely unregulated; relevant norms of existing international law, international space law, and international environmental law apply to space debris as one of the environmental issues.

Article IX of the Outer Space Treaty obliges States Parties to, among others, “conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty.” The requirement of “due regard”, which reiterates the rule of general international law that the legitimate interests of other States must be taken into consideration when a State exercises its right, is viewed as one

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of the limitations on the freedom of outer space. Although what it aims to protect are the “corresponding interests” of other States Parties, it would, nevertheless, contribute to the protection of the space environment. The clause has a “consequence” dimension and a “subjectivity” dimension. First, the creation of a significant amount of space debris, in particular those in the most useful orbits such as Low–Earth Orbits (LEOs) and the Geostationary Orbit (GEO), may jeopardize the “corresponding interests” of other States Parties by posing risks to their activities therein. Second, the conducting State is expected to pay “due diligence” in avoiding unnecessary environmental impacts through, e.g., the implementation of risk assessment and the adoption of cost-effective measures. However, a State is not given the right to subject to its consent another State’s activities in outer space based on possible jeopardies to its space activities.

Article IX further requires States Parties to “pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination”. The term “harmful contamination” in its ordinary meaning can be very broad. Whereas the word “contamination” is inherently negative, meaning the act of pollution or infection, “harmful” retains its ordinary meaning of “causing or capable of causing significant harm”. Therefore, the introduction of pollutants into outer space, which cause or are capable of causing significant harm, should be regarded as “harmful contamination”. It is argued that space debris has become a new form of harmful contamination of outer space.

However, States Parties are only obliged to “avoid” it, and adopt “appropriate” measures “where necessary”. The ambiguous and subjective nature of establishing a standard for avoiding harmful contamination makes it difficult to assess whether there is a violation of the provision.

Article IX also contains a dual consultation regime. First, if a State Party has reason to believe that an activity or experiment planned by it or its nationals in outer space would cause potentially harmful interference with the activities of other States Parties in the peaceful exploration and use of outer space, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. Second, a State Party, which has reason to believe that an activity or experiment planned by another State Party in outer space would cause potentially harmful interference with its activities in the peaceful exploration and use of outer space, may request consultation concerning the activity or experiment. This regime

7 This principle, which can also be found in the UN General Assembly Resolution 1962 (XVIII), was originally proposed by the United Kingdom in response to a Soviet Union draft that required prior consent from potentially affected States. See USSR, “Draft Declaration of the Basic Principles Governing the Activities of States in the Exploration and Use of Outer Space” in *Report of the Committee on the Peaceful Uses of Outer Space*, UNGAOR, 18th Sess, Annexes, Agenda Item 28, UN Doc A/5549 (1963) at 11, Annex III, para 6.
8 *Outer Space Treaty*, *supra* note 3, art IX.
13 *Outer Space Treaty*, *supra* note 3, art IX.
Control over harmful activities

originally aims to safeguard other States’ right to conduct space activities. Ultimately, it would also contribute to the protection of the space environment. However, the obligation to initiate active consultation depends on a subjective determination, which allows a high level of discretion. Even if an affirmative determination is made, there is no guidance as to the procedure and substance of such consultation. In addition, such consultation does not need to achieve certain result(s), and, even if it does, there is no obligation to take into account the result when eventually conducting the concerned space activities.

International law, since its creation, has adhered to no intrinsic geographical limits. Article III of the Outer Space Treaty declares that States Parties are required to “carry on activities in the exploration and use of outer space, ... in accordance with international law, including the Charter of the United Nations”. International law, in particular long-established rules of customary international law and basic and explicit tenets of international law, is thus applicable to space activities. The “no harm” principle, namely the “general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control”, is recognized by the International Court of Justice (ICJ) as “part of the corpus of international law relating to the environment”, hence applicable to activities in the exploration and use of outer space. The term “respect”, which is relative and subjective in nature, echoes the subjectivity element of the “due regard” principle. Applying the “no harm” principle to the control of space debris, it can be concluded that the creation of large amount of debris can cause “damage” to the space environment, and States should pay “due diligence” to avoid debris creation.

14 See Mineiro, supra note 6 at 338–39.
15 Viikari, supra note 12 at 61.
17 Outer Space Treaty, supra note 3, art III.
18 Olivier Bibelink, “Article III” in Stephan Hobe et al., eds, Cologne Commentary on Space Law (Köln: Heymanns, 2009) vol 1, 64 at 67.
19 Legality of the Threat or Use of Nuclear Weapons Case, Advisory Opinio n, [1996] ICJ Rep 226 at 241 [Nuclear Weapons Advisory Opinion]; Gabcikovo-Nagymaros Project (Hungary v Slovakia), [1997] ICJ Rep 7 at 41. The “no harm” principle traces back to the notion of sic iure tuo ut alienum non laedas, i.e. “to use your own property so as not to injure another’s”. See, e.g., G.A.I., “Sic Utire Tuo ut Alienum Non Laedas” (1907) 5:8 Michigan L Rev 673. A few courts and arbitration tribunals had dealt with this principle in the trans-boundary context, but not that of “areas beyond national control”. In the Trail Smelter case, the Mixed Arbitration Tribunal concluded that “no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence”. See Trail Smelter (USA v Canada), Award of 1941, III RIAA 1938, 1965. In the Corfu Channel case, the ICJ recognized “every State’s obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States”. See The Corfu Channel Case (United Kingdom of Great Britain and Northern Ireland v Albania), Merits, [1947] ICJ Rep 4 at 22. The “no harm” principle was recognized in the 1972 Stockholm Declaration and the 1992 Rio Declaration. See Declaration of the United Nations Conference on the Human Environment, 1972, in Report of the United Nations Conference on the Human Environment, UNESC O R, UN Doc A/Conf.48/14/Rev.1 (1972), Principle 21; Rio Declaration on Environment and Development, UN Doc A/CONF.151/5/Rev.1 (1992), 31 ILM 874, Principle 2 [Rio Declaration]. The principle has also found expression in the preambles of the Convention on Long Range Transboundary Air Pollution and the UN Framework Convention on Climate Change, and in Article 194 of the UN Convention on the Law of the Sea (UNCLOS), See Convention on Long-Range Transboundary Air Pollution, 13 November 1979, 1302 UNTS 217; United Nations Framework Convention on Climate Change, 9 May 1992, 1771 UNTS 107; United Nations Convention on the Law of the Sea, 10 December 1982, 1833 UNTS 3, art 194(2) [UNCLOS].
To summarize, both international space law and environmental law are broad and, paradoxically, vague on the control of space debris. The lack of objective criteria and the emphasis on subjectivity allow a high degree of discretion on the part of conducting States, and make it difficult to hold them accountable for harms to the space environment. As far as subsequent practice in treaty application is concerned, which establishes the agreement of the parties regarding the interpretation, the generation of space debris, even those in tests of anti-satellite weapons, has seldom been alleged of violating the due regard principle, the obligation to avoid harmful contamination, or the “no harm” principle, although there have been accusations of non-fulfillment of the consultation obligation.

**UNCOPUOS and IADC Space Debris Mitigation Guidelines**

International efforts aimed at addressing the issue of space debris were initiated in the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS) in the 1990s. However, since the adoption of the 1979 Moon Agreement, States have failed to negotiate any further legally binding agreement relating to outer space under the auspices of the UNCOPUOS. Instead, non-binding instruments are widely being used in the regulation of space activities, and it is the Inter-Agency Space Debris Coordination Committee (IADC), an international governmental forum consisting of major national space agencies, that has first adopted a set of guidelines designed to mitigate the growth of orbital debris population in 2002. The IADC Guidelines then have formed a baseline for the UNCOPUOS to adopt its Space Debris Mitigation Guidelines in 2007, which has been endorsed by the UN in 2008.

The IADC Guidelines cover the overall environmental impact of the space missions with a focus on: (1) limitation of debris released during normal operations, (2) minimization of the potential for on-orbit break-ups, (3) post-mission disposal, and (4) prevention of on-orbit collisions. Organizations are encouraged to use the Guidelines in identifying the standards that they will apply when establishing the mission requirements for planned spacecraft and orbital stages. Operators of existing spacecraft and orbital stages are encouraged to apply the guidelines to the greatest possible extent. The UNCOPUOS Guidelines are overall similar to the IADC Guidelines. Particularly, both Guidelines define “space debris” as “all man-made
objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional”.

However, one of the very few differences between them is that IADC Guidelines recommend a 25-year post-mission orbital lifetime limitation, whereas the UNCOPUOS Guidelines do not.

The IADC Guidelines and the UNCOPUOS Guidelines are a good example of global efforts to counter a common concern amassed from a small number of key players. However, they are limited in a few respects. First, neither of them has retrospective effect: both Guidelines are applicable to mission planning and to the operation of newly designed spacecraft and orbital stages, and existing ones only “if possible” or “to the greatest extent possible”. Second, those Guidelines are voluntary, that is not legally binding under international law. Private companies do not have any legal obligation to observe them unless States integrate them into their domestic law, e.g., through a licensing mechanism. Third, those Guidelines do not seem to apply to security-related activities in outer space. Although they have contributed to the mitigation of space debris resulting from civil activities in outer space, the large number of debris caused by military activities would render their efforts in vain. Fourth, there have been observations that it is difficult to comply with the principles, such as the requirement to avoid collision and to limit orbital lifetime, in the case of orbital stages and satellites that do not have a propulsion system.

The IADC Guidelines and the UNCOPUOS Guidelines only state what is to be achieved regarding debris mitigation, without specifying how to achieve those goals. Complementarily, the International Organization for Standardization (ISO) has developed a family of standards addressing debris mitigation. ISO-24113:2011, which is the top-level standard, defines the primary space debris mitigation requirements applicable to all elements of unmanned systems launched into, or passing through, near-Earth space, including launch vehicle orbital stages, operating spacecraft, and any objects released as part of normal operations or disposal actions.

National and regional regulations

International efforts at space debris mitigation were predated and motivated by regulations at the national level, in particular those in the US and Japan. Ever since the adoption of the IADC and UNCOPUOS Guidelines, a growing number of space-faring nations and international organizations have voluntarily made their own orbital debris mitigation guidelines pursuant thereto. In some States, the requirements have been incorporated into their licensing procedure.

Early in 1988, the US firmed up its policy to minimize the creation of space debris, which was binding on the national security and civil space sectors. In 1995, the National Aeronautics and Space Administration (NASA) became the first space agency in the world to issue a comprehensive set of orbital debris mitigation guidelines, which formed the basis of US

28 UNCOPUOS Guidelines, supra note 25 at para 1; IADC Guidelines, supra note 24 at 5.

29 IADC Guidelines, supra note 24 at 9–10.

30 UNCOPUOS Guidelines, supra note 25 at para 3; IADC Guidelines, supra note 24 at 5.

31 UNCOPUOS Guidelines, supra note 25 at para 3; IADC Guidelines, supra note 24 at 5.


In 1999, the French national space agency, the Centre National d’Études Spatiales (CNES), established the CNES Standard, which served as a basis for the European Code of Conduct for Space Debris Mitigation concluded and signed by the European Space Agency (ESA), and major national space agencies in Europe in 2004. Prior to this Code, the ESA had adopted its European Space Debris Safety and Mitigation Standard and Space Debris Mitigation Handbook, which jointly defined ESA’s policies and implementation concepts on space debris mitigation and collision risk reduction for any mission under ESA control. Additionally, the French Space Operation Act, adopted in 2008, provides that “[t]he authorization granted pursuant to the present Act may include requirements set forth for the safety of persons and property, protection of public health and the environment, in particular in order to limit risks related to space debris”.

In 2000, the Russian Aviation and Space Agency approved its Space Debris Mitigation Standard. The Requirements are applicable to all space assets production and operation activity by the order of Russian Federal Space Agency (ROSCOSMOS). In 2009, the National Standard of the Russian Federation, titled “General Requirement to Design and Operation of Spacecraft and Orbital Stages on Space Debris Mitigation”, came into force. The Standard was harmonized with the UNCOUPOS Guidelines, and applied to newly designed and updated space vehicles (civil, science, commercial, military, and manned missions) of different types at all stages of their life cycle (designing, manufacturing, launch, operation, and disposal).

37 The FCC is responsible for licensing radio transmissions by private entities in the US. For more information on the FCC, see online: Federal Communications Commission www.fcc.gov.
39 NASDA is the predecessor of the Japan Aerospace Exploration Agency (JAXA). For more information, see Japan Aerospace Exploration Agency, “NASDA History”, online: JAXA global.jaxa.jp/about/history/nasda/index_e.html; Japan Aerospace Exploration Agency, “JAXA History”, online: JAXA global.jaxa.jp/about/history/index.html.
46 Russia, General Requirements to Spacecraft and Orbital Stages on Space Debris Mitigation, GOST R 52925–2008 (2009).
47 See Inter-Agency Space Debris Coordination Committee, “Russian Federal Space Agency (ROSCOSMOS)”, online: IADC www.iadc-online.org/members/about_rsa.shtml.
China published the first part of its National Industry Standard – “Requirements on Space Debris Mitigation” – in 2005. The Requirements apply to the design, operational, and post-mission disposal phases of space systems. In December 2009, the State Administration of Science, Technology and Industry for National Defense published the Interim Measures on Administration of Mitigation of and Protection against Space Debris, which are in conformity with the UNCOPUOS Guidelines. China has fully inactivated its Long March rockets, and moved a few aging GEO satellites out of orbit.

Under the Canadian Remote Sensing Act, “[a]n application to the Minister to issue, amend or renew a licence must be made in the prescribed form and manner, be supported by a proposed system disposal plan, [and] proposed guarantee arrangements…” The Minister may not issue a license without having approved that a system disposal plan for the licensed system satisfactory to the Minister that, among other things, provides for the protection of the environment, public health and the safety of persons and property; and arrangements satisfactory to the Minister relating to the guarantee of the performance of the licensee’s obligations under the system disposal plan.

Legal issues concerning active debris removal

As the number of orbital debris continues to grow, Active Debris Removal (ADR) has been called for. However, a number of legal issues need to be addressed in advance. First, there is no universally accepted definition of space debris. The definition in the IADC and UNCOPUOS Guidelines, which is based on “non-functionality”, is not legally binding. Although States have been encouraged to furnish information to the UN Secretary-General when a space object is no longer functional, universal practice on this matter cannot be observed.

Second, even if a space object becomes space debris, it does not naturally follow that any State other than the State of registration is at liberty to remove it without the consent of the State of registration, since this would amount to an intrusion into the jurisdiction and control of the space object’s State of registration. According to the Outer Space Treaty, a State Party on whose registry an object launched into outer space is carried shall “retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body”. The formula “shall retain jurisdiction and control” not only refers to the obligation to

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48 China, Requirements for Space Debris Mitigation, QJ3221-2005.
49 See ibid.
50 The Interim Measures on Administration of Mitigation of and Protection against Space Debris is not publicly available. It is currently under revision by the State Administration of Science, Technology and Industry for National Defense.
53 Ibid., s 9(1).
57 Outer Space Treaty, supra note 3, art VIII.
exercise jurisdiction and control over the space object, but also the right to exercise sovereignty over it.\textsuperscript{58}

Third, in many cases, ADR requires trans-orbit maneuvers and re-entries of satellites, which pose risks to the safety of spacecraft, and of persons and properties on the surface of the Earth or in air. States conducting ADR, and even others falling within the scope of “launching States”, may be held liable for damages under Articles VI and VII of the Outer Space Treaty and the Liability Convention. This possible outcome, albeit deriving from a faithful reading of the treaties, would discourage efforts of ADR.

**Planetary protection**

“Planetary protection” is defined by NASA as “the practice of protecting solar system bodies (i.e., planets, moons, comets, and asteroids) from contamination by Earth life, and protecting Earth from possible life forms that may be returned from other solar system bodies.”\textsuperscript{59} It covers not only “outward contamination”, but also “backward contamination”.\textsuperscript{60}

**International regulations**

**Outer Space Treaty and Moon Agreement**

The issue of planetary protection is addressed in Article IX of the Outer Space Treaty. With respect to “outward contamination”, States Parties undertake to “pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination”.\textsuperscript{61} Contaminations of the space environment can be from biological, chemical or radiation sources. Biological contamination by materials from the Earth, for instance, could make it difficult to accurately determine if life was present on the planet. As to “backward contamination”, States Parties shall avoid “adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter”.\textsuperscript{62} However, the term “adverse changes” has not been defined. It seems, nevertheless, to include only adverse impacts reaching a certain threshold of severity. Furthermore, for both “outward contamination” and “backward contamination”, States Parties shall “adopt appropriate measures”, “when necessary”.\textsuperscript{63} However, Article IX does not provide clear guidance as to the circumstances in which “appropriate measures” shall be adopted, granting States Parties the right to determine the existence of such circumstances, and of specific measures that shall be adopted.

The applicability of general international law to activities in the exploration and use of outer space is affirmed by Article III of the Outer Space Treaty.\textsuperscript{64} In this connection, the precautionary principle in international environmental law, an evolving principle which has achieved customary status in the context of the European Union but international courts and tribunals

\textsuperscript{58} Bernhard Schmidt-Tedd & Stephan Mick, “Article VIII” in Stephan Hobe et al., eds, Cologne Commentary on Space Law (Koln: Heymanns, 2009) vol 1, 146 at 156–58.
\textsuperscript{60} See ibid.
\textsuperscript{61} Outer Space Treaty, supra note 3, art IX.
\textsuperscript{62} Ibid.
\textsuperscript{63} Ibid.
\textsuperscript{64} Ibid., art III.
have been reluctant to accept explicitly such a status, should be applicable in the context of outer space, given the high risks associated with space activities and that a stringent interpretation is necessary. According to the principle, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. The principle is of particular importance in the avoidance of “backward contamination”. For instance, returning spacecraft and astronauts, as well as extraterrestrial materials that they brought back, are sterilized and quarantined in practice.

Compared to the Outer Space Treaty, the Moon Agreement lays down more stringent obligations on planetary protection. It provides that States Parties “shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise”. Discarding the term “when necessary”, it does not leave so much discretion to States Parties in the adoption of measures when conducting potentially harmful space activities. It has also been observed that “disruption of the environment” is a more extensive concept than “harmful contamination” found in the Outer Space Treaty. The Moon Agreement further requires States Parties to “take measures to avoid harmfully affecting the environment of the Earth through the introduction of extraterrestrial matter or otherwise”. “Harmful affection” also seems to be broader than “adverse changes” in the Outer Space Treaty. However, the Moon Agreement only applies to the Moon and other celestial bodies within the solar system, except the Earth. And as of 1 January 2015, there are only 4 Signatory States and 16 Ratifications to the Agreement, compared to 25 and 103 to the Outer Space Treaty.

**COSPAR planetary protection policy**

The Committee on Space Research (COSPAR), a consultative body to the UNCOPUOS, has been playing a leading role in technical aspects of planetary protection. At the second session of its thirty-fourth meeting, held in Houston on October 20, 2002, the COSPAR Council adopted a revised and consolidated Planetary Protection Policy, and has since been continuing to regularly update and amend the Policy. Whereas the 2002 version of the COSPAR Policy concerned robotic missions, it was amended in March 2011 to include Principles and Guidelines for Human Missions to Mars.

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66 See *Rio Declaration*, supra note 19, Principle 15.

67 *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 18 December 1979, 1363 UNTS 3, art 7(1) [Moon Agreement].

68 Viikari, supra note 12 at 62.

69 Moon Agreement, supra note 67, art 7(1).

70 Ibid., art 1(1).


72 To learn more about COSPAR, see Committee on Space Research, “About”, online: COSPAR cosparhq.cnes.fr/about.

The COSPAR Planetary Protection Policy is being maintained and promulgated as a reference for space-faring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration, and to provide accepted guidelines in this area to guide compliance with the wording of the Outer Space Treaty and other relevant international agreements. It makes a distinction between five categories of target body/mission type combinations, and suggests different ranges of requirements for each category. For determinations not covered, advice should be sought through the auspices of the Member National Scientific Institution of COSPAR. If such advice is not available, COSPAR will consider providing such advice through an ad hoc multidisciplinary committee. Members are encouraged to inform COSPAR of their establishment of planetary protection requirements for planetary missions, and provide information to it about the procedures and computations used for planetary protection for each flight and about the areas of the target(s) which may have been subject to contamination. The Policy also includes an Appendix of Implementation Guidelines and Category Specifications for Individual Target Bodies.

The COSPAR Policy focuses on organic-constituent and biological contamination in space exploration. Recently, recommendations have been made to expand the framework to address other forms of “harmful contamination” which go beyond biological and organic-constituent contamination.

**National and regional regulations**

Article IX of the Outer Space Treaty and the COSPAR Policy have been followed by a few major space agencies, such as NASA, ESA, and JAXA. The NASA Planetary Protection Policy is defined by the NASA Policy Directive (NPD), titled “Biological Contamination Control for Outbound and Inbound Planetary Spacecraft”. The Directive covers “all space flight missions, robotic and human, which may intentionally or unintentionally carry Earth organisms and organic constituents to the planets or other solar system bodies, and any mission employing spacecraft which are intended to return to Earth and/or its biosphere from extraterrestrial targets of exploration”. In order to ensure compliance with the Policy, the NASA Office of Planetary Protection maintains the NASA Procedural Requirements (NPR), entitled “Planetary Protection Provisions for Robotic Extraterrestrial Missions”. Crewed planetary missions are currently guided by the NASA Policy Instruction (NPI), titled “NASA Policy on Planetary Protection Requirements for Human Extraterrestrial Missions”, which would help

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74 Ibid., Preamble.
75 Ibid., Policy.
76 Ibid.
77 Ibid.
80 Ibid. at para 2(b).
to obtain scientific information, and to develop the necessary technologies and procedures to draft an NPR for crewed planetary missions.\textsuperscript{82}

NASA Planetary protection requirements for each mission are determined on the basis of the type of mission, the nature of destination, and the planetary bodies that may be encountered during the mission. Compliance with formal implementation requirements assigned to each mission is overseen by NASA's Planetary Protection Officer (PPO). The PPO also requests recommendations from internal and external advisory committees, most notably from the Space Studies Board of the National Research Council, on implementation requirements for missions. It is worth mentioning that those requirements are formulated on the basis of the most current scientific information available about the target bodies and about life on Earth, and recommendations on implementation requirements are routinely reassessed as new information becomes available.\textsuperscript{83}

ESA Planetary Protection Policy requires the Agency to avoid interplanetary contamination when carrying out activities in outer space, and to comply with the COSPAR Planetary Protection Policy in both crewed and robotic missions.\textsuperscript{84} In order to implement the ESA planetary protection requirements,\textsuperscript{85} the Agency maintains three technical standards.\textsuperscript{86}

In 2012, JAXA established a planetary protection safety review board to be part of its safety review panel, in parallel to the safety review board for rocket payload safety and the safety review board for manned mission safety.\textsuperscript{87}

Planetary protection is also regulated domestically through licensing procedure. For instance, the United Kingdom (UK) Outer Space Act requires the licensee to conduct his operations in such a way as to, \textit{inter alia}, “prevent the contamination of outer space or adverse changes in the environment of the earth”.\textsuperscript{88} The Austrian Federal Law relating to space activities provides that the authorization must be issued if, among other things, “the space activity does not cause harmful contamination of outer space or celestial bodies or adverse changes in the environment”.\textsuperscript{89}

\section*{Control over nuclear radiation and regulation of nuclear power sources}

\textit{Partial Test Ban treaty}

Efforts to negotiate an international agreement to prohibit nuclear tests can be traced back to

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\item \textsuperscript{82} NASA, NASA Policy on Planetary Protection Requirements for Human Extraterrestrial Missions, NPI 8020.7, online: NASA planetaryprotection.nasa.gov/documents/.
\item \textsuperscript{83} Ibid.
\item \textsuperscript{84} ESA Planetary Protection Policy is described in ESA/C(2007)112. See, NASA Policy and Requirements, online: NASA http://science.nasa.gov/media/medialibrary/2011/05/13/10_Conley_-_PP_requirementsv3_TAGGED.pdf.
\item \textsuperscript{85} See European Space Agency, ESA Planetary Protection Requirements, ESSB-ST-PP-001, Issue 1.
\item \textsuperscript{86} They are: European Space Agency, Material and Hardware Compatibility Tests for Sterilization Processes, ECSS-Q-ST-70-53C; European Space Agency, Microbial Examination of Flight Hardware and Cleanrooms, ECSS-Q-ST-70-55C; European Space Agency, Bioburden Control of Cleanrooms, ECSS-Q-ST-70-58C.
\item \textsuperscript{87} Yukio Shimizu, “JAXA Has Established a Planetary Protection Safety Review Board for JAXA Deep Space Program” (Paper delivered at the 40th COSPAR Scientific Assembly, held in Moscow, Russia from 2–10 August 2014) [unpublished].
\item \textsuperscript{88} Outer Space Act 1986 (UK), c 38, s 5(2)(e)(i).
\end{itemize}
1955, when the former Soviet Union proposed a cessation of nuclear testing enforced by an international commission as part of an incremental process towards general nuclear disarmament.\textsuperscript{90} Concerns over high-altitude nuclear tests conducted in the early years of human exploration and use of outer space, which created electromagnetic pulse (EMP) that brought severe impacts to satellites, apparently accelerated the negotiations. In 1963, the governments of the former Union of Soviet Socialist Republics (USSR), the US, and the UK concluded the Partial Test Ban Treaty,\textsuperscript{91} and made it open to other States for signature. The Treaty obliges each of its Parties:

[T]o prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control:
(a) in the atmosphere; beyond its limits, including outer space; or under water, including territorial waters or high seas; or
(b) in any other environment if such explosion causes radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control such explosion is conducted …\textsuperscript{92}

States Parties further undertake to “refrain from causing, encouraging, or in any way participating in, the carrying out of any nuclear weapon test explosion, or any other nuclear explosion, anywhere which would take place in any of the environments described, or have the effect referred to,” above.\textsuperscript{93} The phrase “any other nuclear explosion”, as explained by the then US Acting Secretary of State, includes explosions for peaceful purposes, because of the difficulty of differentiating between weapon test explosions and peaceful explosions without additional controls.\textsuperscript{94} Underground tests are banned only if the “explosion causes radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control such explosion is conducted”.\textsuperscript{95}

After the conclusion of the Partial Test Ban Treaty, the number of underground nuclear tests substantially increased, while that of atmospheric nuclear tests decreased,\textsuperscript{96} contributing to the environmental protection of the common areas. Today, the Partial Test Ban Treaty has 91 Signatories, 62 Ratifications, and 36 Accessions.\textsuperscript{97}


\textsuperscript{91} Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, 5 August 1963, 480 UNTS 43 [Partial Test Ban Treaty].

\textsuperscript{92} Ibid., art I(1).

\textsuperscript{93} Ibid., art I(2).

\textsuperscript{94} “Nuclear Test Ban Treaty Signed at Moscow, transmitted to Senate for Advice and Consent to Ratification”, The Department of State Bulletin 49:1261 (26 August 1963) 314 at 319.

\textsuperscript{95} Partial Test Ban Treaty, supra note 91, art I(1)(b).


\textsuperscript{97} See US Department of State, “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies”, online: US Department of State www.state.gov/t/isn/5181.htm.
**Outer Space Treaty**

After the conclusion of the Partial Test Ban Treaty, both the US and the former USSR announced that they had no intention of stationing any objects carrying nuclear weapons or other Weapons of Mass Destruction (WMDs) in outer space. This facilitated the inclusion of the provision prohibiting nuclear weapons in outer space in the Outer Space Treaty without great efforts. Article IV, Paragraph 1 of the Outer Space Treaty provides:

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

Nonetheless, the term “nuclear weapons” has not been defined in the Treaty. The ICJ broadly defined “nuclear weapons” as “explosive devices whose energy results from the fusion or fission of the atom”, regardless of the purpose. By this definition, any nuclear explosive devices in outer space should be considered “nuclear weapons”.

The threat posed by Near Earth Objects (NEOs) is gaining increasing attention in recent years, and the use of nuclear weapons is regarded as a means of last resort in the mitigation. However, the use of nuclear weapons in planetary defense seems to contradict Article I of the Partial Test Ban Treaty, which prohibits any nuclear explosion. The placement of nuclear weapons in outer space, which is regarded as an important measure for the mitigation of NEOs that have very short warning time such as long-period comets, also seems to be prohibited by Article IV of the Outer Space Treaty if we follow the ICJ’s definition of “nuclear weapons”. The right to self-defense enshrined in the UN Charter, which is applicable to activities in outer space, can only be invoked “if an armed attack occurs against a Member of the United Nations”. The ICJ even opined that the armed attack needs to be conducted “by one State against another State”. The right to defend against natural disasters, albeit included in the broad definition of self-defense which literally means “[t]he use of force to protect oneself, one’s family, or one’s property from a real and threatened attack”, is inadequately addressed in the UN Charter and customary international law of self-defense. However, international law does recognize that, in exceptional cases, any State’s necessity to safeguard an essential interest threatened by a grave and imminent peril may outweigh its international obligations, thus precluding the wrongfulness for non-compliance. The preclusion, nonetheless, is subject to two conditions: (a) the act must be the...
only way for the State to safeguard an essential interest against a grave and imminent peril; and (b) the act shall not seriously impair an essential interest of the State or States toward which the obligation exists, or of the international community as a whole.110

Regulation of nuclear power sources

The use of nuclear power in space missions is more advantageous than traditional solar power in at least two respects. First, nuclear power systems function independently of sunlight, enabling spacecraft to operate in areas where there is insufficient solar power. Second, the weight-to-capacity ratio of nuclear power generators is considerably lower than that of solar power systems, thus reducing the cost and increasing the mission length of space missions.111 However, nuclear power sources (NPS) could present hazards to the terrestrial and extraterrestrial environment in the case of, for example, launch failures, in-orbit leaking or break-ups, post-mission break-ups, or re-entries.112

Outer space treaties and nuclear power sources principles

The use of NPS in outer space activities attracts the application of the outer space treaties ipso facto. However, those treaties do not adequately address such use of NPS. The re-entry of the former USSR’s nuclear-powered Cosmos-954 in 1978, which crashed onto and scattered radioactive debris over northwest Canada,113 raised international concerns over risks associated with the use of NPS in space activities. Discussions at the UN resulted in the adoption of Principles Relevant to the Use of Nuclear Power Sources in Outer Space (the NPS Principles) by the General Assembly on December 14, 1992. The Principles are applicable to the use of NPS for the generation of electrical power on board space objects, but not to those for propulsive purposes.114

The NPS Principles restated many principles and rules that had been well-accepted in international space law prior to its adoption by the General Assembly. For instance, the applicability of international law (Principle 1) can be found in Article III of the Outer Space Treaty.115 General principles of international environmental law are thus applicable to the use of NPS in outer space. It follows, inter alia, that, when using NPS in space activities, States must have due regard to the environment of other States and that of areas beyond national jurisdiction. The obligation of consultation appearing in Article IX of the Outer Space Treaty is reiterated in Principle 6.116 International responsibility for national space activities, and liability and

109 See ibid. Whether these conditions are fulfilled would depend on, among others, the mass of the NEO, the odds of impact, the length of warning time, and accessible means.
110 See ibid. at 81–82. For instance, unsuccessful mitigation which brings damage to States, which could have escaped from such damage in the “no action” scenario, would render the preclusion of wrongfulness inapplicable.
114 Principles Relevant to the Use of Nuclear Power Sources in Outer Space, GA Res 47/68, UNGAOR, 1992, UN Doc A/RES/47/68, Preamble [NPS Principles].
115 See ibid., Principle 1; Outer Space Treaty, supra note 3, art III.
116 See NPS Principles, supra note 114, Principle 6; Outer Space Treaty, supra note 3, art IX.
compensation for damage, established in Articles VI and VII of the Outer Space Treaty and the Liability Convention, are restated in Principles 8 and 9.

In addition, the NPS Principles developed some of the then existing principles and rules of space law, and general international law, probably due to the higher potential risks associated with NPS. Principle 4, for instance, explicitly requires the launching State, prior to the launch, to “ensure that a thorough and comprehensive safety assessment is conducted”, which must cover “all relevant phases of the mission and shall deal with all systems involved”.

The NPS Principles also contain some unique principles and rules in response to the unique challenges posed by NPS. For example, Principle 2 adopts a narrower definition of “launching State” : “the State which exercises jurisdiction and control over a space object with nuclear power sources on board at a given point in time relevant to the principle concerned”. In the context of international liability for damage caused by space objects, the term “launching State” is defined as a State which “launches or procures the launching of a space object”, or a State “from whose territory or facility a space object is launched”. Thus, the applicability of this definition and rules regarding liability for damage caused by a space object, already provided for in the Outer Space Treaty and the Liability Convention, has been reaffirmed. Whereas the broad definition of “launching State” would enable victims to promptly seek remedies, echoing the victim orientation of the Liability Convention, the narrow definition in the NPS Principles gives more precise guidance as to who bears the special obligation to safely use NPS in outer space. The NPS Principles, therefore, impose additional obligations on States, who are considered as launching States according to the narrow definition under Principle 2, while preserving the general principles for the attribution of liability for damage. Furthermore,


118 See NPS Principles, supra note 114, Principles 8, 9.

119 Ibid., Principle 4.1. Another example is the obligation to share information and to assist. Principle 5 requires the launching State, in the event that a space object with NPS on board is malfunctioning with a risk of re-entry of radioactive materials to the Earth, to inform States concerned “as soon as the malfunction has become known”, update the information “as frequently as practicable”, and disseminate the updated information in increasing frequency. See NPS Principles, supra note 114, Principle 5. Principle 7 requires all States possessing space monitoring and tracking facilities to communicate, in the case of re-entry of a space object containing a NPS, “the relevant information that they may have available on the malfunctioning space object with a nuclear power source on board to” the UN Secretary-General and the concerned State “as promptly as possible”. Ibid., Principle 7.1. After re-entry, the launching State, other States, and international organizations with relevant technical capabilities shall promptly offer the necessary assistance. Ibid., Principle 7.2. Whereas the launching State naturally has the obligation to share information and provide assistance so as to minimize the damage, third-party States’ obligations to provide information and render assistance in such disasters are not yet widely recognized, although there have been similar examples. According to the Remote Sensing Principles, States participating in remote sensing activities that have identified information in their possession that is capable of averting any phenomenon harmful to the Earth’s natural environment shall disclose such information to States concerned. See Principles relating to Remote Sensing of the Earth from Space, GA Res 41/65, UNGAOR, 1986, UN Doc A/RES/41/65, Principle X [Remote Sensing Principles]. States that have identified processed data and analyzed information in their possession, which may be useful to States affected by natural disasters, or likely to be affected by impending natural disasters, shall transmit such data and information to States concerned as promptly as possible. See Remote Sensing Principles, ibid., Principle XI.

120 NPS Principles, supra note 114, Principle 2.1.

121 Liability Convention, supra note 117, art I(C); Outer Space Treaty, supra note 3, art VII.

122 NPS Principles, supra note 114, Principles 2.2, 9.1.
Principle 3 restricts the use of NPS in space activities to “those space missions which cannot be operated by non-nuclear energy sources in a reasonable way”.  

IAEA documents

The International Atomic Energy Agency (IAEA) was created in 1957 in response to the deep fear and expectation resulting from the discovery of nuclear energy. The Agency works with its Member States and multiple partners worldwide to promote safe, secure, and peaceful use of nuclear technologies. The IAEA has used non-binding standards to ensure nuclear safety in outer space.

In 1996, the IAEA published the Safety Series Document on Emergency Planning and Preparedness for Nuclear Powered Satellite Re-entry. The document has been prepared to assist States in their response to possible re-entry events in announcement, locating, monitoring, and recovery phases. The document contains nine Annexes.

In 2009, the IAEA and the UNCOPOUS jointly published the Safety Framework for Nuclear Power Source Applications in Outer Space. The Safety Framework, which is voluntary, provides “a foundation for the development of national and international intergovernmental safety frameworks”. Its focus is on the protection of people and the environment in Earth’s biosphere from potential hazards associated with relevant launch, operation, and end-of-service mission phases of space NPS applications. The protection of humans in space engaged in missions using NPS, and the protection of the environments of other celestial bodies are beyond the scope of the Safety Framework. The Safety Framework lays down guidance for governments and relevant international intergovernmental organizations that authorize, approve or conduct space NPS missions, guidance for the management of the organization involved in space NPS applications, and technical guidance for organizations involved in space NPS applications.

Conclusion

Existing international space treaties appear inadequate to address the challenge posed by the proliferation of space debris, which was not envisaged when the treaties were negotiated. International efforts on space debris mitigation since the late 1980s have contributed to the slow-down of the increase of debris. However, the challenge remains due to the intensified militarization of outer space and the increase and diversification of space actors. The

\[123\] Ibid., Principle 3. The NPS Principles also recognize, in its preamble, that “the use of nuclear power sources in outer space should focus on those applications which take advantage of the particular properties of nuclear power sources”. Ibid., Preamble.


\[126\] Ibid. at 1.

\[127\] Ibid. at 2.

\[128\] Ibid. at 2–3.

\[129\] Ibid. at 4.

\[130\] Ibid. at 5.
Control over harmful activities

Conduction of active debris removal, which is gaining increasing support in the political and academic circles, will need to be based on not only its technical feasibility and economic viability, but also the resolution of a number of legal and policy issues such as a generally accepted definition of space debris, the sharing of space situational awareness, and the sharing of risks associated with the removal.

Whereas the regulation of planetary protection is similarly ambiguous in the Outer Space Treaty, COSPAR and various leading national space agencies have expounded sets of detailed policies in preventing interplanetary contaminations. It is foreseeable that more attention will be exerted on planetary protection with the further development of space activities, such as lunar exploration and space mining. It is highly recommended that the further elaboration of planetary protection policies should be guided by the precautionary principle, given the high risks associated therewith and potentially irreversible damages caused thereby.

The control over nuclear radiation in outer space is achieved through the prohibition of nuclear tests and nuclear weapons in outer space on the one hand, and the regulation of nuclear power sources on the other hand. Whereas the control has been largely effective in both respects, the question arises as to whether the prohibition of nuclear weapons in outer space would bar States from employing them for the purpose of planetary defense should it become necessary. It is worth noting that general international law does provide moderate flexibilities in this regard.