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ORIGINAL ARTICLE

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Out of sight, out of mind? The proliferation of space debris and international law

Diego Zannoni

University of Padua, Department of Political Science, Law and International Studies, Via del Santo 28 - 35123 Padua, Italy
Email: diego.zannoni@unipd.it

Abstract

The quantity of man-made space objects, ranging from abandoned launch vehicle stages to fragmentation debris, is remarkable. At the time, the drafters of the Outer Space Treaty did not (and perhaps could not) anticipate how great the problem of debris in outer space would one day become. As a result, they only drafted general provisions for the protection of the space environment which are generally deemed insufficient. This article aims to demonstrate that both general rules of international law and the UNCOPUOS Debris Mitigation Guidelines come to the rescue in addressing the space debris issue as they complement and complete the general obligations contained in the Outer Space Treaty. Particular attention is paid to anti-satellite weapon tests, which have catastrophic consequences in terms of creating debris but nonetheless continue to be carried out. Finally, it ascertains whether an obligation on states to actively remove their space debris exists.

Keywords: celestial bodies; environmental protection; outer space; space debris; space object

1. Introduction

The benefits of space activities like telecommunications and remote sensing, to name but a few, have traditionally enjoyed ample media coverage. Probably less universally known are the side-effects of exploration and use of outer space. Space debris, also known as 'space garbage', is one of these. It includes disused satellites, rocket bodies, burnt-out engines, pieces of launch mechanisms, discarded spacecraft, and a vast array of fragments, the majority of which cannot be detected from Earth with the present state of the art. The quantity of these objects is remarkable and the situation is likely to deteriorate as the number of launches continues to increase. One might think of the emergence of mega-constellations of satellites and the greater risk of debris they unavoidably entail.[1] Miniaturization of satellites has rendered their launch and operation more widely available and is also contributing to the multiplication of objects in space.

From a legal point of view, the crucial issue is to establish if, and eventually how, it is possible to reconcile the two principles in Article I of the Outer Space Treaty (OST) which are at stake here.[2] In fact, Article I OST declares that space shall be free for exploration and use, on the one hand, but sets limits to this freedom by making it dependent on the benefit to and interests of all countries,

[1]Report of the Scientific and Technical Subcommittee on its fifty-seventh session, UN Doc. A/AC.105/1224 (2020), at 19, para. 104.

[2]1966 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 610 UNTS 205. As of 1 January 2020, the OST is binding on 110 states. Moreover, 23 states have signed it and are therefore obliged to refrain from acts which would defeat the object and purpose of the treaty under Art. 18 VCLT.

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on the other. Therefore, new launches are *per se* allowed and protected by the freedom of exploration and use. Since space debris is an unavoidable by-product of space activities – from launch to disposal, and beyond – the emission of space debris also appears to be permissible. At the same time, however, a duty to maintain the sustainability of space activities is inherent in Article I OST,[3] in the sense that sustainability of space activities is a prerequisite for enduring freedom to explore and use outer space. With spacecraft being at risk of catastrophic collisions even with small pieces of space debris, an increase in the amount of debris could hinder this freedom and ultimately reduce the prospects of exploring outer space.[4] The use of orbits could be similarly affected and this would, in turn, jeopardize the proper functioning of all terrestrial activities dependent on satellites.[5] Against this background, it is unsurprising that the 2019 Guidelines for the long-term sustainability of outer space activities adopted by the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS)[6] contain several rules devoted to space debris mitigation.[7]

To date, there is no international treaty relating to the mitigation of debris and, within the UNCOPUOS, states' views on what further steps to take differ. According to some states, spacefaring nations have an interest in preserving the safety and long-term sustainability of space activities, with the consequence that they will even voluntarily abide by non-binding guidelines. Moreover, mitigation techniques are constantly subject to change due to the evolution of technologies. It has, therefore, been claimed that it would be neither necessary nor opportune to develop legally binding space debris mitigation standards at present.[8] In contrast, other states have expressed the view that binding rules on the sustainable conduct of space activities should be developed at the international level to foster predictability and uniformity,[9] including enhancing the existing system for registering space objects.[10] In particular, some states hold that the major contributors to space debris should take appropriate responsibility for its removal under an internationally agreed framework.[11] The lack of consensus makes it easy to guess that legally binding instruments for debris mitigation will not be adopted in the near future, which is an additional reason for carefully examining the relevant international law as it stands.

[3]S. Marchisio, *Protecting the Space Environment*, in Proceedings of the 46th Colloquium on the Law of Outer Space, 2003, at 11. Sustainability has gained considerable importance in the conduct of space activities and the issue is currently being examined by the Scientific and Technical Sub-committee of UNCOPUOS under the Agenda item 'Long-Term Sustainability of Outer Space Activities'. The Sub-Committee put this item on its agenda in 2010. See Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/64/20 (2009), at 23, para. 161.

[4]Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/74/20 (2019), at 12, para. 71, and at 17, para. 116 (2019 UNCOPUOS Report); cf. 'Decision No 541/2014/EU of the European Parliament and of the Council of 16 April 2014 establishing a Framework for Space Surveillance and Tracking Support', (2014) *Official Journal of the European Union* 158, at 228, recital no. 7.

[5]For the qualification of orbits as 'limited natural resources', see Constitution of International Telecommunication Union Art. 44.

[6]The UNCOPUOS is a subsidiary organ of the General Assembly, under Art. 22 of the UN Charter. Its internal division, which consists of two sub-committees, the Scientific and Technical Sub-committee and the Legal Sub-committee, was created to link the legislative process of international space law with rapid advances in technology and science.

[7]See the 2019 Guidelines for the Long-term Sustainability of Outer Space Activities, UN Doc. A/AC.105/C.1/L.366 (2019), in particular Guideline A.2, para. 2(b), B.3 and D.2 (hereafter Long-term sustainability Guidelines).

[8]Report of the Legal Subcommittee on its fifty-eighth session, UN Doc. A/AC.105/1203 (2019), at 24, para. 163; Report of the Scientific and Technical Subcommittee on its fifty-sixth session, UN Doc. A/AC.105/1202 (2019), at 21, para. 123. In contrast with this optimistic view, it should, however, be remembered that most mitigation measures introduce some burden on missions. For instance, requiring each satellite to be equipped with de-orbiting capacity would also mean that states would have to reserve the last bit of fuel to de-orbit the satellite with an ensuing reduction in the length of use of the satellite. See L. Viikari, *The Environmental Element in Space Law* (2007), at 4.

[9]Report of the Scientific and Technical Subcommittee, ibid., at 121, paras. 124–125; Report of the Legal Subcommittee, ibid., at 24, para. 165; see also at 25, paras. 167, 168.

[10]Report of the Legal Subcommittee, ibid., at 25, para. 173. See the 1974 Convention on Registration of Objects Launched into Outer Space (resolution 3235 (XXIX), annex), 1023 UNTS 15.

[11]Report of the Scientific and Technical Subcommittee, *supra* note 1, at 19, para. 105.

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The purpose of this article is to ascertain whether states have specific obligations to prevent an increase in space debris and so protect the space environment. To this end, the article analyses Article IX OST, which addresses both harmful contamination of outer space and harmful interference with the space activities of other states. Light is shed on the interaction between Article IX OST, general international law, and the UNCOPUOS Debris Mitigation Guidelines.[12] In particular, in view of the tremendous impact that anti-satellite testing has on space debris proliferation, the article assesses whether this activity is eventually subject to any obligations to respect and protect the environment. Finally, it ascertains whether an obligation on states to actively remove their space debris exists. Numerous studies indicate that as space debris increases in quantity the primary source of new space debris will be collisions,[13] especially in low earth and geostationary orbits, which are the most crowded.[14] A mere containment approach will soon no longer be sufficient to meet the preservation needs of the space environment.

2. A legal definition of space debris

Definitions of space debris have been adopted in a number of instruments. The ILA Draft Convention focuses on the fact that space debris is not an 'active or otherwise useful' man-made object,[15] while the IADC Guidelines focus on lack of functionality, which is defined as the ability of a spacecraft to 'fulfil its intended mission'.[16] Using the IADC Space Debris Mitigation Guidelines as a starting point, the UNCOPUOS Scientific and Technical Subcommittee drafted its Debris Mitigation Guidelines and adopted the IADC debris definition focusing on the lack of functionality. Although the function of the UNCOPUOS definition is to limit the scope of application of the Guidelines, it is likely to have an impact on future international practice and to become a benchmark in this domain. Indeed, with resolution 62/217 the UN General Assembly endorsed the UNCOPUOS Guidelines,[17] agreeing that they reflected existing practices as developed by a number of national and international organizations and invited member states to further implement them through relevant national mechanisms.[18]

[12]Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (Report of the Committee on the Peaceful Uses of Outer Space, UN Doc. A/62/20 (2007), at 17, paras. 118–119 and at 47–50, Annex) (hereafter UNCOPUOS Guidelines).

[13]UNCOPUOS Guideline 3 (*Limit the probability of accidental collision in orbit*).

[14]Collisions between satellites produce a number of fragments, some of which may be capable of fragmenting another object on collision creating even more fragments. The result would be an exponential increase in the number of objects over time, creating a self-sustaining debris belt around the Earth. This is also known as the Kessler Effect. See D. J. Kessler and B. G. Cour-Palais, 'Collision Frequency of Artificial Satellites: The Creation of a Debris Belt', (1978) *Journal of Geophysical Research* 2637–46.

[15]ILA Draft International Instrument on the Protection of the Environment from Damage Caused by Space Debris, Art. 1(c), adopted by the Sixty-Sixth Conference of the International Law Association, Buenos Aires, 1994. The text can be found in K. H. Böckstiegel, 'ILA Draft Convention on Space Debris', (1995) 44 ZLW 29 –34. A satellite with a payload which is no longer able to transmit data to Earth is no longer active, but it could continue to be useful because of the information stored on board.

[16]See the combination of Arts. 3.1 and 3.2.1 of the Inter-Agency Space Debris Mitigation Committee (IADC) Space Debris Mitigation Guidelines, Revision 1 – September 2007. See also the similar definition of space debris provided in Art. 2, no. 18 of the Proposal for a Regulation establishing the space programme of the Union and the European Union Agency for the Space Programme, COM/2018/447 final, 2018/0236 (COD).

[17]International cooperation in the peaceful uses of outer space, A/RES/62/217 (2007), at 6, para. 26. This paragraph was part of the resolution adopted without a vote.

[18]Ibid., at 7, para. 27. The Scientific and Technical Subcommittee recognizes that they have been adopted or implemented so far by several states and international organizations. See, Report of the Scientific and Technical Subcommittee, *supra* note 1, at 18, para. 97. The Long-term sustainability Guideline A.2 recommends that states should further 'implement space debris mitigation measures, such as the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space'. For an overview of international practice see the Compendium of Space Debris Mitigation Standards adopted by states and international organizations, available at www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html.

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The UNCOPUOS definition is, on the one hand, narrower and on the other hand, broader than that in the IADC Guidelines. It is narrower because it generally states that space debris is non-functional without referring to the inability of the object to fulfil 'its *intended* mission'.[19] This is worth noting because it is not uncommon for a satellite to be repurposed after having surpassed its estimated useful life or after a technical anomaly renders it unfit for its primary function. On the other hand, the UNCOPUOS definition could be deemed broader because it solely refers to the actual status of non-functionality, without considering that a space object can stay in standby mode for a long time awaiting possible re-activation. By contrast, both the ILA Draft and the IADC Guidelines positively consider this eventuality and specify that an object is not regarded as space debris if reactivation is possible.[20] To avoid absurd conclusions – for instance that a temporary glitch in functionality downgrades a space object to space debris – the UNCOPUOS definition should be interpreted consistently with these guidelines. In summary, in order to account for the eventualities of temporary inactivity and repurposing, a space object should be considered space debris as soon as it is no longer of practical use and a change to this status cannot be reasonably expected in the foreseeable future. No doubt, as long as these requirements are met even an intact satellite can be classified as space debris, notwithstanding the etymological origin of this term in the French word 'débriser' (to break up).[21]

One might argue that dwelling on a definition of space debris is a mere academic exercise because whether a particular 'space object' is functional or conversely 'space debris' ultimately depends on an assessment by the operating state. However, operating states do not enjoy an unlimited margin of discretion in this regard and have to apply the definition provided by the Guidelines in good faith, especially in cases of a collision between a functional and a non-functional object.[22] Active satellites and manned space stations arguably take precedence over debris in cases of collision. Article I OST can, in fact, be interpreted as recognizing states' freedom to use outer space only to the extent that a space activity is aimed at and sustained by a purpose of exploration or use. Considering that space debris is by definition non-functional, it increases the risk of collisions for no justifiable reason and poses a threat to the exploration and use of outer space by other states without serving anybody's interests.[23] The ITU regime on the management of radio frequencies is governed by the same principles. Protection of assigned frequencies and orbital positions is contingent on their actual and continued use.[24] Therefore, in cases of collision the fact that one of the two objects is a piece of space debris should be considered when assessing the fault requirement for liability to arise under the terms of Article III of the Liability Convention.[25] Fault by the launching state of the non-functional object should be presumed. This conclusion is further supported by the IADC and UNCOPUOS Guidelines, which warn against the dangers of inactive space objects and recommend their removal.[26]

The Registration Convention requires a launching state to provide information on the 'general function' of a space object and its orbital parameters to the UN Secretary-General.[27] Nevertheless, the lack of specific data on the functional status of space objects, the vague requirement to provide

[19]IADC Guideline 3.2.1 (emphasis added).

[20]IADC Guidelines Art. 3.2.1; ILA Draft Convention Art. 1(c).

[21]In this sense see C. Q. Christol, *Scientific and Legal Aspects of Space Debris*, in Proceedings of the 36th Colloquium on the Law of Outer Space, 1993, at 372; L. Perek, *Legal Aspects of Space Debris: A View from Outside the Legal Profession*, in Proceedings of the 38th Colloquium on the Law of Outer Space, 1995, at 53.

[22]One might think of the collision which took place in 2009 between the American Iridium 33 satellite, which was still active at the time, and Cosmos 2251, a no longer functional Russian satellite.

[23]In this sense see M. K. Force, *When the Nature and Duration of Space Becomes Appropriation: "Use" as a Legal Predicate for a State's Objection to Active Debris Removal*, in Proceedings of the 56th Colloquium on the Law of Outer Space, 2013, at 415.

[24]See ITU Radio Regulations, 2016 Edition Art. 11 (*Notification and recording of frequency assignments*).

[25]P.-M. Martin, 'Les Débris Spatiaux: Remarques sur le Visible et l'Invisible en Droit', (1994) 43 ZLW 30–7, at 35.

[26]On space debris removal see *infra* Section 10.

[27]1974 The Convention on Registration of Objects Launched into Outer Space Art. IV (hereafter Registration Convention).

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registration information 'as soon as practicable' and to discretionally update it 'from time to time' and the failure to properly empower the UN Secretary-General to demand updates to this effect render the Registration Convention mostly ineffective in the fight against debris.[28] Several instruments coherently emphasize the need to enhance the practice of registering space objects. In particular, GA Res 62/101 usefully recommends providing the Secretary-General with more specific information, including 'any change of status in operations (inter alia, when a space object is no longer functional)' and 'the approximate date of decay or re-entry, if States are capable of verifying that information'.[29] The legal framework in place is more stringent for satellites in geostationary orbit. For these, the ITU registration procedure contains a number of useful elements for an objective functionality assessment. Article 11 of the Radio Regulations requires that the 'date of bringing into use' and the nature of service of a satellite system be clearly marked in the registration notice. Moreover, any alteration of the basic characteristics of a registered satellite must be notified to the Bureau if the frequency assignment is to retain its original date of entry and the corresponding level of international protection. Therefore, any subjective assessment by the registering state might be countered by an objective assessment by the ITU.

Indeed, in most cases the Bureau relies on information provided by the registering state to periodically review its master register and the registering state may not be likely to admit that one of its satellite systems is non-functional. However, according to Article 13.6 of the Radio Regulations, the Bureau may also initiate inquiries 'whenever it appears from reliable information available' that a frequency assignment is not being used. If it is found that the frequency assignment does not correspond to an operating satellite, the assignment will be deleted from the register. Removal from the register of a previously recorded assignment should trigger a presumption that the corresponding satellite is no longer considered valuable by the registering state, as harmful interference might impair its functioning without any protection by the ITU.

Therefore, mandatory provision of information to the ITU would be helpful in establishing the debris status of inactive satellites in geostationary orbit and provide the basis for further action. Admittedly, such a suspicion of non-functionality rests on the presupposition that the relevant satellite was actually registered in the first place, which is not a legal requirement for launching a space object but a technical requirement for obtaining international protection from harmful interference by other users. Nevertheless, whether or not registration has taken place or been withdrawn seems worthy of consideration.

3. The liability approach

The doctrinal debate on space debris often develops from a liability standpoint and hence from the question of whether space debris falls within the definition of 'space object' or 'component parts' so as to trigger the application of Article VII OST and the Liability Convention in cases of damage.[30] However, focusing on the liability regime seems neither sufficient nor opportune[31]

[28]On the limits of the Registration Convention see F. Von der Dunk, *Space Debris and the Law*, Proceedings of the Third European Conference on Space Debris, 2001, at 865; P. D. Man, 'The Relevance of ITU Regulations for Clarifying the Space Debris Concept and Strengthening Guidelines on the Removal of Satellites at the End of Their Functional Life', (2013) 38 *Annals of Air & Space Law* 203–36, at 214–16.

[29]Cf. Recommendations on enhancing the practice of states and international intergovernmental organizations in registering space objects, UN Doc. A/RES/62/101 (2007), at 3, para. 2(b). See also the Long-term Sustainability Guideline A.5, which recommends that states and international intergovernmental organizations should take into account General Assembly resolution 62/101.

[30]1972 Convention on International Liability for Damage Caused by Space Objects, 961 UNTS 187. See M. Pedrazzi, *danni causati da attività spaziali e responsabilità internazionale* (1996), at 82–9, 110–22; F. Von Der Dunk, *supra* note 28, at 863–8.

[31]In general, for authors supporting that liability regimes are not appropriate tools for international environmental protection, see J. Brunnée, 'Of Sense and Sensibility: Reflections on International Liability Regimes as Tools for Environmental Protection', (2004) 53 ICLQ 2, 351–68; T. Scovazzi, 'State Responsibility for Environmental Harm', (2001) 12(1)

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– not because space debris cannot be included in the notion of 'space object'[32] but instead because of other legal limitations inherent in the liability approach and practical considerations. First of all, and this is the legal limit, the very notion of damage in Article VII OST and the Liability Convention is limited to damage to a state party or private persons.[33] Damage to the environment would be included on the sole condition that a state or a person was affected – a hypothesis which is negligible in outer space.[34] However, even from a practical point of view a liability approach causes some perplexity. Indeed, a key preoccupation driving the debate on space debris is to protect the fragile space environment against potentially irreversible harm, not to compensate victims of personal injury or property damage. Furthermore, in most cases it is impossible to trace a fragment back to the object from which it originated and therefore to identify the state liable.[35] Establishing an 'International Outer Space Clean-Up Fund' aimed at providing compensation for damage caused by unidentifiable space debris has so far remained nothing but a doctrinal proposal.[36] Therefore, the high road to take is arguably not that of liability for damage but that of prevention of space debris, focusing on the nexus between preventive obligations in the conduct of space activities and responsibility. This does not mean that the liability regime in this sector can be ignored, of course. Quite the contrary, it constitutes a deterrent to space debris proliferation and is arguably the main approach to take in cases of collisions between identifiable space objects.[37]

4. The duty to avoid harmful contamination

In its opening sentence Article IX OST specifies that states' space activities are to be guided by the principle of co-operation and mutual assistance and conducted 'with due regard' to the corresponding interests of all other states parties.[38] It then continues in a symmetrical fashion, referring to the terrestrial environment, which must be protected from any 'adverse changes' resulting from the introduction of 'extra-terrestrial' matter, on the one hand, and to the possible 'harmful contamination' of outer space and celestial bodies arguably deriving from terrestrial matter, on the other.

The admonition against adverse changes to the terrestrial environment refers to so-called 'back contamination' and is not applicable to debris. It is true that debris might fall to Earth and contaminate the terrestrial environment[39] but debris is, by definition, of human not extra-

Yearbook of International Environmental Law 43–67, at 51. See also the well-known passage in the ICJ's *Gabcikovo* judgment: 'The Court is mindful that, in the field of environmental protection, vigilance and prevention are required on account of the often irreversible character of damage to the environment and of the limitations inherent in the very mechanism of reparation of this type of damage.' *Gabcikovo-Nagymaros Project (Hungary/Slovakia)*, Judgment of 25 September 1997, [1997] ICJ Rep. 7, at 74, para. 140.

[32]For a broad interpretation of the term 'space object' encompassing space debris see, *ex multis*, P. Stubbe, *State Accountability for Space Debris* (2018), at 373–5, 388–90.

[33]See the wording of Art. VII OST and the definition of damage in Art. I(a) of the Liability Convention.

[34]L. Condorelli, 'La réparation des dommages catastrophiques causés par les activités spatiales', in *La réparation des dommages catastrophiques* (1990), at 288–90. The ILA Draft Convention extends the notion of damage to cover 'any adverse modification of the environment of areas within or beyond national jurisdiction or control'.

[35]On the limits of the application of the liability regime to space debris see T. G. Nelson, 'Regulating the Void: In-Orbit Collisions and Space Debris', (2015–2016) *Journal of Space Law* 105–30, at 114–21, 123–4.

[36]For instance, it was proposed that each state should contribute to the Fund according to its 'actual use' of the space 'environment', and a useful indicator for this purpose could be the profit made from or the cost involved in launches. S. Ospina, *Outer Space: 'Common Heritage' or 'Common Junkyard' of Mankind?*, in Proceedings of the 30th Colloquium on Outer Space Law, 1987, at 231. See also A. N. Pecujlic and S. K. Germann, 'Global Cap and Trade System for Space Debris: Putting a Price on Space Hazards', (2015–2016) *Journal of Space Law* 131–45.

[37]On the reparative function of liability see R. Lefeber, *Transboundary Environmental Interference and the Origin of State Liability* (1996).

[38]On the origins of Article IX OST see S. Marchisio, 'Article IX', in S. Hobe, B. Schmidt-Tedd and K.-U. Schrogl (eds.), *Cologne Commentary on Space Law* (2009), vol. 1, at 556–60.

[39]On this point see *infra* Section 10.

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terrestrial origin. What is relevant to our reasoning is instead the other part of the rule, which requires states 'to avoid ... harmful contamination' of outer space and celestial bodies (this is so-called 'forward contamination') and to 'adopt appropriate measures for this purpose'. According to the wording of Article IX, these obligations apply solely to the performance of studies and the conduct of exploration without mentioning the use of outer space. However, a combined reading with the first part of Article IX, where the due regard rule is set out, leads to the applicability of the obligations 'to avoid their harmful contamination' and to 'adopt appropriate measures for this purpose' even to the use of outer space.[40] Indeed, the due regard rule refers to both 'exploration' and 'use' and the latter obligations are nothing but a specification of the due regard rule.[41]

As far as the notion of 'harmful contamination' is concerned, two paths of reasoning are available. One might argue that any contamination is per se harmful and should be avoided insofar as it implies by definition a modification of the environment through human agency. On the other hand, and this is the second path, one might emphasize that Article IX OST does not prohibit any kind of contamination unless it can be considered 'harmful'.[42]

This is the preferable interpretation. Indeed, if any contamination were harmful the use of this adjective in Article IX would be redundant. The French version of the OST points to '*les effets préjudiciables de leur contamination*', and therefore assumes more explicitly than the English version that contamination *per se* is not harmful. This interpretation can also be confirmed by a combined reading of Article IX with Article I, which declares that outer space and celestial bodies are free to be explored and used. If contamination were generally harmful, taking into consideration that space activities inevitably result in debris and hence contamination, the only viable way of avoiding it would be to ban space activities *tout court*. However, this would be a paradoxical conclusion as the purpose of the Outer Space Treaty is to promote the exploration and use of outer space, not to restrict them.[43]

Article IX OST seems to be nothing but the expression and application to outer space of the international rule on the prohibition of transboundary harm[44] and as such should be interpreted accordingly in virtue of Article 31, paragraph 3 of the VCLT.[45] Indeed, the so-called no harm rule also applies if places beyond the national jurisdiction are affected, including the high seas, Antarctica and indeed outer space. That the territory of another state does not need to be involved was specifically clarified by the ICJ in its *Nuclear Weapons* Advisory Opinion,[46] shifting the focus

[40]In this sense, see also P. Achilleas, *Planetary Protection-Legal Issues*, in Proceedings of the 46th Colloquium on the Law of Outer Space, 2003, at 215. This author argues that the rule imposing avoidance of harmful contamination is a general principle of space law and, as such, is also applicable to the use of outer space. On this point see *infra* in the text.

[41]The great majority of legal doctrine hinges on the alleged ambiguity of Art. IX, putting into doubt its effectiveness. See, *ex multis*, F. Lyall, *Protection of the Space Environment and Law*, in Proceedings of the 42nd Colloquium on the Law of Outer Space, 1999, at 474; H. Almond, *A Draft Convention for Protecting the Environment of Outer Space*, in Proceedings of the 23rd Colloquium on Law of Outer Space, 1980, at 101; N. Jasentuliyana, 'Space Debris and International Law', (1998) 26 *Journal of Space Law* 139–62, at 141; 159–60; L. Viikari, *supra* note 8, at 110–11. Even more trenchant is C. Gray: 'Current space law has nothing to say about space debris.' C. Gray, 'Global Commons, Space Power and Strategy', in *ISPI Quaderni di relazioni internazionali* (2008), at 10.

[42]In this sense, but as a critical note, see S. Gorove, 'Pollution and Outer Space: A Legal Analysis and Appraisal', (1972) *New York University Journal of International Law and Politics* 53–66, at 62; Viikari, ibid., at 111.

[43]See para. 2 of the OST preamble.

[44]It is well-known that the rule was already applied in the *Trail Smelter* case (United States of America, Canada, 16 April 1938, 3 UNRIAA, at 1905–1982).

[45]It is true that the 1969 Vienna Convention on the law of Treaties (VCLT), according to its Art. 4, only applies to treaties concluded after its entry into force on 27 June 1980 and can therefore not apply to the Outer Space Treaty. However, the International Court of Justice has repeatedly confirmed that Arts. 31 and 32 of the VCLT laying down the fundamental principles regarding the interpretation of treaties are a reflection of customary international law. See, *ex pluribus, Pulp Mills on the River Uruguay (Argentina v. Uruguay)*, Judgment of 20 April 2010, [2010] ICJ Rep. 14, at 46, para. 65.

[46]'The existence of 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 now part of the corpus of international law relating to the

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of international protection from the territorial integrity of a particular state to the protection of the environment *per se*.

Just like the general no harm rule, Article IX OST also seems to be interpreted as imposing on states not an absolute obligation of result but one of diligent conduct.[47] Therefore, as long as states adopt appropriate measures to avoid harmful consequences of their space activities they will be released from any responsibility even if harm is caused.[48] This is, of course, without prejudice to liability for damage eventually caused to other states if the requirements laid down in Article VII OST are met.

5. Standards for assessing harmfulness

Assuming that the harmfulness of a certain activity must be measured by its potential contribution to the accumulation of debris, the issue is to establish the level beyond which contamination becomes harmful/préjudiciable. In this regard, a joint reading of the avoid harmful contamination rule and the due regard principle in Article IX suggests that a space activity produces harmful contamination when it disrespects the interests of other states and undermines their freedom to explore and use outer space.[49] A space activity which significantly increases the risk of collision and thus of space debris in a crowded orbit, for instance, hampers the freedom of other states to explore and use outer space and causes harmful contamination. There is arguably an intimate connection between harmful contamination of outer space and potential harmful interference with present and future space activities of other states, in that potential harmful interference with space activities can be used as a parameter to assess whether a certain type of contamination reaches the threshold of harmfulness and must therefore be avoided. It is not a coincidence that the drafters of the OST decided to address in the same Article IX both the issue of harmful contamination of outer space and that of harmful interference with other space activities.[50]

The UNCOPUOS Guidelines play a fundamental role in harmfulness assessment. They interact with the binding rules in Article IX in that, although not compulsory in themselves, they complement and complete the general obligations it contains. Having been adopted by consensus both by the UNCOPUOS and the UN General Assembly, the UNCOPUOS Guidelines encompass a common understanding by all the parties to the OST as to their proper interpretation. They can be considered 'subsequent practice' of the state parties according to Article 31(3) of the Vienna Convention and can, as such, provide elements to be taken into account in the

environment.' *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion of 8 July 1996, [1996] ICJ Rep. 226, at 19, para. 29. For a critical assessment of the use of the expression 'jurisdiction and control' rather than 'jurisdiction or control' see E. B. Weiss, 'Opening the door to the Environment and to Future Generations', in L. B De Chazournes and P. Sands (eds.), *International Law, the International Court of Justice and Nuclear Weapons* (1999), at 340. The passage quoted was then recalled in the *Gabcikovo-Nagymaros Project* case, where the ICJ emphasized 'the great significance that it attaches to respect for the environment, not only for States but also for the whole of mankind'. *Gabcikovo-Nagymaros Project (Hungary/Slovakia)*, *supra* note 31, at 41, para. 53.

[47]In the sense that the 'no harm rule' is an obligation of conduct see, *ex multis*, A. E. Boyle, 'State Responsibility and International Liability for Injurious Consequences of Acts Not Prohibited by International Law: A Necessary Distinction?', (1990) 39 ICLQ 1–26, at 14–15 and the literature it cites; A. Gattini, 'International Responsibility of the State and International Responsibility of Judicial Persons for Environmental Damage: Where do we stand?', in Y. Levashova, T. Lambooy and I. Dekker (eds)., *Bridging the gap between International Investment Law and the Environment* (2015), at 117; P. Birnie, A. Boyle and C. Redgwell, *International Law and the Environment* (2009), at 137; T. Scovazzi, *supra* note 31, at 49–50.

[48]*Contra*, focusing on the wording of this part of Art. IX OST, P. Stubbe argues that this norm ought to be regarded as prohibiting contamination in absolute terms and obliging states to adopt a certain conduct to this end: P. Stubbe, *supra* note 32, at 158–62. However, the author himself then recognizes that Art. IX OST is the 'space-specific' expression of the no harm rule. Ibid., at 247.

[49]In this sense see also Stubbe, ibid., at 158.

[50]On the consultation mechanism established in Art. IX OST in the case of potential interference with other space activities see Section 8.

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specification of the appropriateness of the measures to adopt. In more concrete terms, they offer the standards of due diligence against which a state's conduct should be assessed.[51]

Due to the fact that any introduction of matter into outer space increases collision risk and so threatens the interests of other states, new matter should be limited to what is strictly necessary for the purpose of its introduction.[52] Article 44 of the ITU Convention accordingly defines radio frequencies and any associated orbital positions, including the geostationary satellite orbit, as 'limited natural resources' and imposes on member states the obligation to use them rationally, efficiently and economically.

Given that the consequences of a single launch in terms of its contribution to increasing the amount of debris are not foreseeable with absolute certainty, the precautionary principle assumes a prominent role in determining what standards and regulations states must adopt to prevent harmful contamination.[53] Coupled with the due diligence requirement, the precautionary principle implies that a state undertaking a space activity must adopt the best available practices and standards.[54] These are arguably the only 'appropriate' measures for minimizing, if not avoiding, harmful contamination.[55]

While the standards to adopt and the degree of appropriateness evolve in step with technology,[56] they also depend on the capability of the state concerned, on the overall state of the orbit in which the activity is carried out and, in general, on the level of risk involved in a specific operation.[57] Therefore, standards are characterized by a certain degree of dynamism, but this does not affect the verifiability of the degree of appropriateness in a particular context on a case-by-case basis. Moreover, states do not have complete discretion in defining the 'measures' to adopt. Indeed, the duty to adopt appropriate measures in Article IX OST is substantiated in further duties, namely the duties to carry out an environmental impact assessment of the planned space activity, to notify and to consult.

6. Environmental impact assessment

The consistent jurisprudence of the ICJ leaves no doubt as to the customary status of the obligation to perform an environmental impact assessment (EIA) before commencing activities that may have a significant adverse impact in a transboundary context. This was declared in the

[51]P.-M. Dupuy, 'Soft Law and the International Law of the Environment', (1991) 12 *Michigan Journal of International Law* 420–35, at 434.

[52]The ITU Recommendation on environmental protection of the geostationary satellite orbit consistently specifies that 'as little debris as possible should be released into the GSO region during the placement of a satellite in orbit'. Environmental protection of the geostationary-satellite orbit, Rec ITU-R S.1003-2 (12/2010).

[53]According to the precautionary approach, when there are threats of 'serious or irreversible damage' to the environment, lack of scientific certainty cannot be invoked by states in order to postpone preventive measures (see principle 15 of the Rio Declaration). 'This obligation applies in situations where scientific evidence concerning the scope and potential negative impact of the activity in question is insufficient but where there are plausible indications of potential risks. A sponsoring State would not meet its obligation of due diligence if it disregarded those risks.' *Responsibilities and obligations of States with respect to activities in the Area*, Advisory Opinion, 1 February 2011, ITLOS Reports 2011, 10, at 46, para. 131. The Law of the Sea Tribunal has come the closest to acceptance of the customary nature of the precautionary approach: 'it is appropriate to point out that the precautionary approach is also an integral part of the general obligation of due diligence of sponsoring states, which is applicable even outside the scope of the Regulations'. Ibid., para. 131. See also *Pulp Mills*, *supra* note 45, at 71, para. 164.

[54]See *Responsibilities and obligations of States with respect to activities in the Area*, Advisory Opinion, ibid., at 48, paras. 136–137.

[55]Cf. UNCOPUOS Guideline 1.

[56]*Responsibilities and obligations of States with respect to activities in the Area*, Advisory Opinion, *supra* note 53, at 43, para. 117.

[57]'The standard of due diligence against which the conduct of the State of origin should be examined is that which is generally considered to be appropriate and proportional to the degree of risk of transboundary harm in the particular instance.' Para. 11 of the commentary to Art. 3, Draft Articles on Prevention of Transboundary Harm from Hazardous Activities.

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Pulp Mills case[58] and confirmed in the joint cases *Certain Activities Carried Out by Nicaragua in the Border Area* and *Construction of a Road in Costa Rica along the San Juan River*.[59] In the latter case, the obligation to perform an EIA was invoked by both parties. According to Costa Rica, Nicaragua should have conducted such an assessment before carrying out dredging works[60] whereas according to Nicaragua, Costa Rica breached the same obligation in relation to the construction of the road.[61]

The fact that most judicial decisions relate to the transboundary application of EIAs should not lead to exclusion of the application of this obligation to areas beyond national jurisdiction. Indeed, there is a symmetry between the scope of application of this obligation and of the general no harm rule, which it derives from.[62] Likewise, the fact that Article IX OST does not explicitly contemplate an obligation to carry out an EIA has no relevance. As the perhaps pleonastic Article III OST clarifies, states are to carry out space activities 'in accordance with international law'.[63] As a general requirement of international law, the EIA is therefore also applicable to space activities.

The real issue here is to establish the role that ascertaining risk might have in this context. One might pragmatically argue that an EIA should be undertaken whenever a planned activity entails a significant risk in a transboundary or international context, while it should simply be skipped if the risk is *icto oculi* low or even absent as it would unnecessarily overburden domestic administrations. It is, on the contrary, submitted that, in line with the rationale of an EIA, ascertaining risk should be the outcome of the process rather than one of its constitutive elements. The performance of an EIA for each planned activity might enable the consideration and choice of more environmentally sound options. The current status of Earth's environment calls for the inclusion of environmental concerns in each planned activity, not only in those entailing an *icto oculi* significant risk. Even the reduction of low environmental impacts can have an overall benefit for the environment. However, also from a legal point of view, making the performance of an EIA contingent on the existence of a risk unnecessarily complicates the issue by triggering further and difficult-to-solve problems. In particular, it would be hard to establish which risk thresholds to apply in the context of the preliminary assessment and the EIA. These thresholds would arguably not correspond to that required to prove that significant transboundary harm has actually been caused.[64]

[58] *Pulp Mills*, *supra* note 45, at 72, para. 204.

[59] *Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)* and *Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica)*, Judgment of 16 December 2015, [2015] ICJ Rep. 665, at 706, para. 104. M. A. Fitzmaurice defines EIAs as the 'very fundamental of contemporary environmental law and the heart of prevention'. See M. A. Fitzmaurice, *International Protection of the Environment* (2001), at 284.

[60] *Certain Activities Carried Out by Nicaragua*, ibid., at 705, para. 100.

[61] Ibid., at 719, para. 146.

[62] For the application of the obligation to perform an EIA even when the harm might affect areas beyond the national jurisdiction, see *Responsibilities and obligations of States with respect to activities in the Area*, Advisory Opinion, *supra* note 53, at 51, para. 148. The reasoning of the Seabed Disputes Chamber is, however, loose because it used the ICJ's recognition of the customary obligation in a transboundary context as the legal basis to extend its spatial scope to areas beyond national jurisdiction. However, the existence of a customary obligation in a transboundary context does not necessarily mean that the obligation has the same status in areas beyond national jurisdiction. On the environmental aspects of this advisory opinion see L. Pineschi, 'The Duty of Environmental Impact Assessment in the First ITLOS Chamber's Advisory Opinion', in N. Boschiero et al. (eds.), *International Courts and the Development of international Law: Essays in Honour of Tullio Treves* (2013), at 425–39.

[63] F. Durante argues that Art. III OST has a pleonastic character because when states operate in outer space they continue to operate as members of the international community, i.e., as legal entities whose relations are regulated by international law to the extent that it is compatible with special rules enacted for the space environment. F. Durante, 'La codificazione dei principi sull'esplorazione e l'utilizzazione dello spazio extra-atmosferico', in *Le droit international à l'heure de sa codification. Etudes en l'honneur de Roberto Ago* (1987), vol. II, at 160.

[64] *Certain activities*, *supra* note 59, Separate Opinion of Judge *ad hoc* Dugard, at 849, para. 19.

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Therefore, the point is not whether or not an EIA is compulsory but instead to identify the depth of the EIA a state should perform.[65] This assessment should be carried out diligently taking into account the characteristics of the planned activity and in compliance with the precautionary approach.[66] For activities which empirically entail a very low risk of harm being done it will be sufficient to carry out a 'light' EIA, while an extensive one will be required for activities which empirically entail a significant risk.

The International Law Commission cites space activities as an example of ultra-hazardous activities,[67] and one might argue that a risk of harmful contamination is presumed in any space activity. However, the depth of the EIA will depend on concrete assessments to be carried out on a case-by-case basis. A cubesat and a space station, and objects with and without nuclear power sources on board, arguably do not pose the same risks.

This leads us to the last point, i.e., the content of the EIA and the existence of a *noyeau dur* of information that the EIA has to obtain. In the *Pulp Mills* case, the Court left the choice of the modality of the EIA to the state.[68] In this respect, Judge Bhandari posited in his separate opinion that, despite its regional nature, the Espoo Convention could be used as a 'standard that nation States should strive toward'.[69] Based on this idea, he suggested what he deemed could constitute a 'lowest common denominator'[70] for conducting an EIA, including descriptions of the activity and of potential alternatives.[71]

Such a detailed approach seems difficult to reconcile with the general nature of obligations that characterizes customary norms, and in any case with current practice and the *opinio juris* of states. In the current stage of development of international law, the content of an EIA can be solely determined by the international treaties that states are party to or by non-binding guidelines such as the UNCOPUOS Guidelines on Space Debris Mitigation.[72] The latter pragmatically consider the entire life cycle of the space object and in each phase from design to disposal contemplate safeguards to curtail the production of mission-related space debris. These include proper planning of passivation measures to avoid break-ups,[73] specific designs to increase the trackability of space objects,[74] a minimum de-orbiting capability to avoid collisions[75] and periodic controls to detect malfunctions.[76] An EIA for space activities should accordingly carefully consider all these aspects along the entire life cycle of the space object about to be launched. For this purpose, a uniform

[65]*Contra*, L.-A. Duvic-Paoli keeps the distinction between a preliminary assessment that evaluates whether the planned activity should be subject to an EIA and the EIA itself: L.-A. Duvic-Paoli, *The Prevention Principle in International Environmental Law* (2018), at 212.

[66]In this sense see also Birnie, Boyle and Redgwell, *supra* note 47, at 171; 'Almost by definition, ultra-hazardous activities must be carried out through the adoption of measures of "ultra-prevention" of harm.' T. Scovazzi, *supra* note 31, at 49.

[67]For the qualification of space activities as ultra-hazardous see the ILC Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, para. 4 of the Commentary to Art. 1.

[68]*Pulp Mills*, *supra* note 45, at 82 and 83, paras. 204–205; see also *Certain activities*, *supra* note 59, at 706, para. 104.

[69]*Certain Activities*, *supra* note 59, Separate opinion of Judge Bhandari, at 801, para. 33.

[70]Ibid., at 803, para. 41.

[71]Ibid., at 805, paras. 45–46.

[72]*Pulp Mills*, *supra* note 45, at 79, para. 197.

[73]UNCOPUOS Guidelines 2 and 5; IADC Mitigation Guideline 5.2.2. The main causes of fragmentation are currently explosive events due to residual fuel or the batteries on board. Think of the break-up of a Proton launch stage belonging to the Russian Federation in 2007, for example.

[74]UNCOPUOS Guideline 1; see also the Long-term sustainability Guideline B.8: 'Design and operation of space objects regardless of their physical and operational characteristics.'

[75]Several strategies, including the shielding of the critical components of a spacecraft, can be adopted to protect a spacecraft from the consequences of orbital debris impacts. See UNCOPUOS Guideline 3.

[76]UNCOPUOS Guideline 2; see also 5.2.2 IADC Mitigation Guidelines. Art. 4.1.2 (n. SD-DE-05) of the European Code of Conduct for Space Debris Mitigation is even more detailed and sets a specific break-up probability threshold.

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metric could be developed for the environmental footprint of each new mission to evaluate its impact on the space environment.[77]

The obligation to undertake an EIA should induce states to draw up a debris mitigation plan for each new space activity[78] and to impose it on private entities as a licensing condition with the aim of demonstrating the projected space activity's compliance with the debris mitigation requirements.[79] Indeed, under Article VI OST, states have to ensure that national private activities are carried out in conformity with the Outer Space Treaty, including its Article IX. States could also more carefully explore the option of regulatory incentives.[80] For instance, a link could be legally established between the adoption of more stringent debris mitigation measures and a lower required level of insurance. In this manner, far from being an end in itself, an EIA could well bring improvements in the design of space projects and the integration of environmental considerations in them.

7. Notification

If the EIA confirms that there is a risk of harmful contamination or interference, the state planning to undertake the space activity is required to notify potentially affected states in conformity with its due diligence obligation with the aim of determining the appropriate measures to prevent or mitigate this risk.[81] It is admittedly true that the obligation to notify in cases of potential harmful interference with other space activities is not explicitly contemplated in Article IX OST. This is nonetheless a necessary assumption because the rule enabling other state parties to request consultation in cases of potential harmful interference with their space activities would otherwise be ineffective.[82] The rationale of the obligation to notify is clearly to lead the parties to consult and create the conditions for successful co-operation, enabling them to assess the impact of their planned activities on the environment and on other space activities with the fullest possible information and, if necessary, to negotiate the adjustments needed to avoid or at least minimize the risk.[83] The duty to notify amounts to a legal obligation and, in order to implement it, spacefaring nations should at least issue an official statement at the international level before a potentially harmful space activity takes place. This results in overall benefits in terms of transparency and public participation.

As long as the obligations to perform an EIA and to notify are assessed independently, a separate application would allow the judge to hold states responsible for two distinct breaches.[84] This could be particularly useful in those circumstances (as in the *Pulp Mills* case, and in the OST) where applicable treaty provisions are specific about other obligations – notification or consultation – but more vague or even silent in relation to the performance of an EIA.

[77]In this sense see Statement by the European Space Agency on Space Debris at the 2020 Scientific and Technical Subcommittee (6 February 2020).

[78]European Code of Conduct for Space Debris Mitigation Art. 3.3 (no. SD-MM-03).

[79]The UK Outer Space Act, for example, requires the licensee to conduct its operations in such a way as to prevent the contamination of outer space or adverse changes to the environment of the Earth. See UK Outer Space Act of 1986, Sec. 5 e) i).

[80]In this sense see the Long-term sustainability Guideline B.8, para. 2. On this see S. J. Garber, 'Incentives for Keeping Space Clean: Orbital Debris and Mitigation Waivers', (2017) 49 *Journal of Space Law* 179–202.

[81]*Certain Activities*, *supra* note 59, at 706, para. 104. International practice leaves little doubt that the EIA must be communicated to potentially affected states. Cf. *South China Sea Arbitration (The Republic of Philippines v. The People's Republic of China)*, PCA Case N° 2013-19, at 395–6, paras. 987–991.

[82]See the final part of Art. IX OST.

[83]*Pulp Mills*, *supra* note 45, at 59, para. 115; see also *MOX Plant (Ireland v. United Kingdom)*, Provisional Measures, Order of 3 December 2001, [2001] ITLOS Rep. 95, at 110, para. 84.

[84]In this sense see also E. Ruozzi, 'The Obligation to Undertake an Environmental Assessment in the Jurisprudence of the ICJ: A Principle in Search of Autonomy', (2017) 8 *European Journal of Risk Regulation* 158–69, at 169.

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8. Consultation

The obligation to undertake consultations in cases of potential harmful effects being foreseen as a consequence of a particular space activity is the only procedural obligation which Article IX explicitly contemplates. Article IX admittedly limits the application of this obligation to potential harmful interference between space activities while the potential harmful contamination of outer space is not considered. However, the intimate connection between harmful contamination of outer space and potential harmful interference with the space activities of other states has already been emphasized, in the sense that the former necessarily entails the latter, and vice versa. The effectiveness of even this part of Article IX has nonetheless been found to be curtailed by uncertainties in its interpretation. It has been noted that no deadline is mentioned for consultations, with the consequence that talks could go on and on and in the meantime serious – and possibly irreversible – damage could be caused to the Earth or the space environment.[85] To add to the obscurity underlying Article IX, it has been claimed that the requirement for a state having 'reason to believe' that its activity may cause damage to request consultation is left entirely to the discretion of that state. Indeed, it may have no 'reason to believe' and yet the activity could entail harmful consequences.[86] Finally, it has been noted that Article IX does not provide any clue to the legal consequences in cases in which the states concerned are not able to reach an agreement.[87]

All these interpretations trying to demolish the compulsory value, and ultimately the useful effect, of Article IX OST are untenable.[88] First of all, although no deadlines are established, one point is clear: consultations are to take place, or at least start, before a 'planned' space activity takes place, both because of the wording 'before proceeding with any such activity or experiment' and because they would otherwise be largely deprived of their utility. Second, although it is true that potentially affected states have no right to veto a project with a risk of significant harm, while consultations are underway the project should not be carried out precisely because the aim of consultations is to arrive at an equitable and satisfactory solution for all.[89] Finally, dwelling on the subjectivity of the assessment seems to be out of place. Given the lack of a mandatory jurisdiction in international law, the legal dynamics of the process of interaction between states mainly involve them self-interpreting legal rules.[90] Therefore, although the expression 'has reason to believe' could seem to make self-interpretation 'more unilateral' than the interpretation of other international law rules, self-interpretation is far from being a prerogative of Article IX OST. At the same time, the principles of good faith and reasonableness spontaneously restrain and mitigate the unilateralism and discretion underlying self-interpretation of international law.

[85] *Ex multis* Gorove, *supra* note 42, at 63–4; M. Williams, 'Safeguarding Outer Space: On the Road to Debris Mitigation', in *Security in Space: The Next Generation: Conference Report, 31 March-1 April 2008, United Nations Institute for Disarmament Research (UNIDIR)* (2008), at 86.

[86] N. Mateesco-Matte, 'Environmental Implications and Responsibilities in the Use of Outer Space', (1989) 14 *Annals of Air & Space Law* 419–48, at 430; Gorove, *supra* note 42, at 63; M. Williams, ibid., at 87; Nelson, *supra* note 35, at 122–3.

[87] K.-H. Böckstiegel, 'The Settlement of Disputes Regarding Space Activities', in G. Lafferranderie and D. Crowther (eds.), *Outlook on Space Law Over the Next 30 Years* (1997), at 237–8.

[88] The ICJ recalled the principle that a treaty must not be interpreted in such a way that would render parts of the text redundant or meaningless in *Fisheries Jurisdiction (Spain v. Canada)*, Jurisdiction of the Court, Judgment of 4 December 1998, [1998] ICJ Rep. 432, at 455, para. 52; *Application of the International Convention on the Elimination of All Forms of Racial Discrimination (Georgia v. Russian Federation)*, Preliminary Objections, Judgment of 1 April 2011, [2011] ICJ Rep. 70, at 125–6, paras. 133–134.

[89] See Espoo Convention, Implementation Committee's findings and recommendations further to a submission by Romania regarding Ukraine, Meeting of the Parties to the Convention on Environmental Impact Assessment in a Transboundary Context, ECE/MP.EIA/10 (2008), Annex 1, at 91, para. 53.

[90] On the concept of self-interpretation see G. Abi-Saab, 'General Cours', in *Recueil des cours* (1987), vol. VII, at 223; R. Kolb, *Interprétation et création du droit international* (2006), at 286; A. Tanzi, *Introduzione al diritto internazionale contemporaneo* (2019), at 235–6.

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First of all, treaty interpretation and performance are guided by the good faith principle,[91] which implies that the legal arguments underlying a state's claims today cannot be refuted tomorrow when relied on against that state by other states. States need to be aware that rules of law and material situations are reversible, in the sense that a country blamed for being a polluter today could very well end up being a victim of space debris tomorrow. This should lead them not to interpret Article IX OST arbitrarily. Finally, in addition to being unconvincing for an international judge, an unreasonable and legally unfounded claim would be unacceptable and hardly credible for the other states concerned, the international community and public opinion, even outside the judicial context.[92] This is particularly relevant to our purposes because the obligations relating to the preservation of the space environment have an *erga omnes* character. Therefore, any state is entitled to invoke the responsibility of the polluting state even if it is not directly affected by the breach.[93] In conclusion, one cannot really support the view that Article IX does not provide any definitions concerning the time and features of consultations.[94]

Article IX admittedly does not provide for a formalized dispute settlement procedure leading to a binding decision by any particular body should the parties not be able to agree on a settlement. However, as long as an EIA confirms that a planned space activity may cause harmful interference with the space activities of other states, each involved state has the right to trigger the consultation mechanism. Refusing to hold consultations amounts to a breach of the OST, and so would any unjustified breach of the talks and systematic refusal to take into consideration adverse proposals.[95] Against this background, it is finally possible to assess the most concerning action regarding debris proliferation.

9. The intentional destruction of space objects

Clearly enough, being generally carried out to test anti-satellite weapons, the intentional destruction of space objects is intertwined with the broader and topical issue of the lawfulness of military use of outer space.[96] It is well-known in this respect that the crucial interpretation of the adjective 'peaceful', which is used several times in the OST to qualify the purposes space activities are to be carried out for, is not univocal. This term could be interpreted as either 'non-military' or 'non-aggressive'.[97] If the first interpretation were to be adopted, the solution would be straightforward: any military use of outer space, including anti-satellite weapon tests, would be prohibited.

[91]VCLT Arts. 26, 31.

[92]Abi-Saab, *supra* note 90, at 226.

[93]On the possibility for any state to invoke responsibility in the case of a breach of an obligation to protect the environment of international space see R. L. Johnstone, *Offshore Oil and Gas Development in the Arctic under International Law* (2015), at 222–5; G. Gaja, 'States having an Interest in Compliance with the Obligation Breached', in J. Crawford, A. Pellet and S. Olleson (eds.), *The Law of International Responsibility* (2010), at 961; Scovazzi, *supra* note 31, at 62–3. In addition, the interest at stake to maintain the freedom of exploration and use of outer space is apparently not a particular interest of a state party but of the international community as a whole. Therefore, the obligation to avoid harmful contamination is due to all states. See V. Kopal, *Outer Space as a Global Common*, in Proceedings of the 40th Colloquium on the Law of Outer Space, 1997, at 108–18.

[94]L. Viikari even argues that such consultations might be necessary before any future launch of a space object because space objects always tend to turn into or produce some debris that may gravely interfere with the space activities of all states: Viikari, *supra* note 8, at 60. However, this thesis really seems to go too far.

[95]*Lac Lanoux Arbitration* (*France v. Spain*), 16 November 1957, (1957) 12 RIAA 281, at 307.

[96]The doctrinal debate on the lawfulness of the military use of outer space is vast. See, *ex multis*, M. Gestri, 'Portata e limiti del principio dell'uso pacifico nel diritto dello spazio', in F. Francioni and F. Pocar, *Il regime internazionale dello spazio* (1993), at 51–78; L. Condorelli and Z. Mériboute, 'Some Remarks on the State of International Law Concerning Military Activities in Outer Space', (1985) *Italian Yearbook of International Law*, at 3.

[97]For the arguments supporting the 'non-military' interpretation see the passionate pages in G. Gal, *Space Law* (1969), at 164–72.

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However, all the arguments in support of either interpretation seem rebuttable and international practice seems to support the narrower one.

As far as anti-satellite weapon testing is concerned, UNCOPUOS Guideline 4 states that 'the intentional destruction of any on-orbit spacecraft and launch vehicle orbital stages ... should be avoided'[98] except in cases where break-ups are 'necessary'. Within UNCOPUOS, some delegations argue that the intentional destruction of space objects should be legally prohibited.[99] Others emphasize the need to submit such destruction to criteria and procedures.[100] International practice is not univocal. Some spacefaring nations continue to carry out anti-satellite weapon tests,[101] yet any new test triggers stronger protests and calls for consultations by the international community.

Against this background, two paths of reasoning are available. One might argue that Article IX OST in combination with Guideline 4 supports the argument that anti-satellite weapon testing is per se inherently unlawful, except for cases where break-ups are 'necessary'.[102] Indeed, the energy converted by the impact of anti-satellite weapons, even in low-Earth orbits, would render any resulting space debris uncontrollable and hence increase the risk of collision. Under this perspective, contamination stemming from anti-satellite weapon testing is by definition harmful and the only way to avoid it is to refrain from anti-satellite testing.

On the contrary, and this is the more convincing path, one might emphasize that a specific prohibition is needed to be truly effective.[103] After all, even states claiming that the intentional destruction of space objects should be legally prohibited implicitly but unequivocally assume that it is not prohibited so far.[104] However, this does not mean that states carrying out anti-satellite testing are free from any limits and obligations. In this regard, a parallel might be drawn with the contiguous field of nuclear weapon testing. It is well known that the ICJ has twice decided not to rule on the merits on whether such activities are contrary to international law. While in the first application the arguments of the parties were based on the existing norms of international law setting the traditional rules on mutual respect of sovereignty by states,[105] several years later the Court decided to address the issue of nuclear testing from a different perspective, focusing on obligations of states to respect and protect the environment. As mentioned, even in this latest case, the Court did not rule on the merits, thus avoiding applying any rules involving these obligations.[106] However, by way of *obiter dicta*, the ICJ referred to 'the development of international law in recent decades'[107] and indicated that its order was 'without prejudice to the obligations of states to respect and protect the natural environment, obligations to which both New Zealand and

[98]See UNCOPUOS Guideline 4; IADC Mitigation Guidelines 5.2.3. The European Code of Conduct is even more trenchant: 'Intentional destruction of a space system or any of its parts in orbit is prohibited.', Art. 4.1.2 (n. SD-DE-04).

[99]Report of the Legal Subcommittee, *supra* note 8, at 26, para. 184.

[100]2019 UNCOPUOS Report, *supra* note 4, at 30, para. 230.

[101]In 2019, India destroyed one of its own satellites that was in low-earth orbit. The Indian ASAT test increased the number of states in possession of this capability to four. In 2021, Russia destroyed one of its inactive satellites and created over 1,500 pieces of debris.

[102]One might think of the 'necessary' destruction of a space object posing a potential danger to the population on the ground.

[103]In this sense see also Pedrazzi, *supra* note 30, at 117.

[104]On the lawfulness of anti-satellite weapon testing see also S. Marchisio, 'Gli usi militari dello spazio: scenari internazionali e tavoli negoziali', in S. Marchisio and U. Montuoro, *Lo spazio cyber e cosmico* (2019), at 159.

[105]The applicant states argued that France had been infringing the fundamental principle of freedom of the high seas by imposing a no-fly and no-shipping zone in the area where the tests were taking place. The parallel with the freedom to explore and use outer space is quite evident. See the *Nuclear Tests Case* (*Australia v. France*), Application Instituting Proceedings, 9 May 1973, at 51, para. 49; *Nuclear Tests case (New Zealand v. France)*, Application Instituting Proceedings, 9 May 1973, at 8, para. 28. For an overview of these cases see A. Pietrobon, 'Nuclear Powers' Disarmament Obligation under the Treaty on the Non-Proliferation of Nuclear Weapons and the Comprehensive Nuclear Test Ban Treaty', (2014) 27 LJIL 169–88, at 171–2.

[106]Request for an Examination of the Situation in Accordance with Paragraph 63 of the Court's Judgment of 20 December 1974 in the *Nuclear Tests (New Zealand v. France)* case, Order of 22 September 1995, [1995] ICJ Rep. 288.

[107]Ibid., at 306, para. 63.

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France have in the present instance reaffirmed their commitment'.[108] Indeed, both France and New Zealand had recognized the existence of a general obligation to prevent environmental damage, and in particular obligations relating to EIA.[109] The relevance of this reasoning to this work is obvious. Even admitting that anti-satellite testing is not per se contrary to international law, it must in any case be submitted to the environmental obligations outlined above.[110]

In particular, while a risk of harmful contamination is presumed in any space activity,[111] this presumption is not rebuttable in the case of anti-satellite weapon tests. As a result, notification to the international community before testing is always compulsory, as is a consultation on request of other states within the framework of an EIA.[112] Moreover, as Guideline 4 recommends, destruction should be performed only at sufficiently low altitudes to limit the orbital lifetime of resulting fragments.[113] This part of Guideline 4 is binding via Article IX as long as it is the only appropriate measure to avoid long-lasting harmful contamination.

10. Debris de-orbit and removal

Debris mitigation instruments contain specific guidelines for low earth orbits (LEOs) and the geostationary orbit (GEO) with the final objective of limiting the presence of spacecraft in these protected areas after the end of their operational phase and therefore to avoid collisions. Because of their particular characteristics, these orbits are indeed the most crowded.[114]

The UNCOPUOS Guidelines contemplate two separate rules for LEOs and the GEO.[115] Guideline 6 states that non-functional space objects that pass through the LEO region should be removed from orbit in a controlled fashion. This consists in re-entering the space object into the Earth's atmosphere.[116] If removal is not possible, satellites 'should be disposed of in orbits that avoid their long-term presence in the LEO region'.[117] Guideline 7 states that non-functional space objects that pass through the GEO region should be left in orbits that avoid 'long-term interference' with the GEO region.[118] Disposal to a higher orbit normally is the only viable way to remove objects from the GEO. Natural forces such as atmospheric drag do not exert sufficient power for re-entry.

The two alternatives outlined – disposal to a dedicated higher orbit and re-entry – of course entail some side-effects and risks. Disposal to a higher orbit has side-effects because it leads to the creation around the Earth of a belt of debris like those around Saturn. Even re-entry is not without risks. Although objects usually burn up with the heat of friction with atmospheric gases, the most

[108]Ibid., para. 64.

[109]Request for an Examination, *supra* note 106, Application Instituting Proceedings, 21 August 1995, at 36–40, paras. 73–82.

[110]For this reason, it makes no sense to emphasize the need to submit the intentional destruction of space objects to criteria and procedures (see 2019 UNCOPUOS Report, *supra* note 4, at 30, para. 230). They are already there. The point instead is to make them more specific and procedurally stringent.

[111]See *supra* Section 6.

[112]In this sense see also M. Mineiro, 'The United States and the Legality of Outer Space Weaponization: A Proposal for Greater Transparency and a Dispute Resolution Mechanism', (2008) 33 *Annals of Air & Space Law* 441–68, at 456; B. L. Hart, 'Anti-Satellite Weapons: Threats, Laws and the Uncertain Future of Space', (2008) 33 *Annals of Air & Space Law* 344–81, at 378–9; S. G. Gunasekara, 'Mutually Assured Destruction: Space Weapons, Orbital Debris, and the Deterrence Theory for Environmental Sustainability', (2012) 37 *Air and Space Law* 141–164, at 160–1.

[113]See UNCOPUOS Guideline 4; IADC Mitigation Guideline no. 5.2.3.

[114]For definitions of LEO and GEO see IADC Guideline 3.3.2(1) and 3.3.2(2).

[115]In order to facilitate consensus, the UNCOPUOS Guidelines leave out many technical aspects in comparison to the IADC Guidelines. They do not speak of de-orbiting (for the definition of 'de-orbit,' see IADC Guideline 3.4.2) but generally of removal, and also the so-called 25- year rule is not made explicit: '25 years [is found] to be a reasonable and appropriate lifetime limit'. IADC Guideline 5.3.2.

[116]On re-entry see also IADC Space Debris Mitigation Guideline 5.3.2; Art. 5.4 European Code of Conduct.

[117]In similar terms see the long-term sustainability Guideline A.4, para. 6.

[118]See also the ITU Recommendation, *supra* note 52.

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compact pieces of debris reach the ground. Think of the uncontrolled re-entry of Soviet Cosmos 945 in 1978, that of the US space laboratory Skylab in 1979, and that of the Chinese Long March 5B rocket in 2020. It is precisely because of these side-effects and risks that technologies for debris docking and removal, and for on-orbit servicing are in development.[119]

In virtue of a combined reading of Article IX OST and UNCOPUOS Guidelines 6 and 7, and taking into account the technology available, states are already required to design and produce their satellites so that, once they have completed their operational phase, they can be de-orbited. If this is not possible for technical reasons,[120] they are required to plan them to be injected into an orbit in which natural decay would be possible or 'long-term interference' with the LEO and GEO region would be avoided. French legislation explicitly contemplates these requirements and is a model to follow. Indeed, the French Decree on Technical Regulation provides that in order to operate in low earth orbit a space object must be designed and produced so that once it has completed its operational phase it can be de-orbited.[121] If this is not possible for technical reasons, it is to be produced and placed so that it is no longer present in the LEO region more than 25 years after the end of its mission.[122]

In the current stage, studies on active debris removal are mostly theoretical but, as mentioned above, technologies necessary for debris docking and removal will soon be available. Therefore, a further issue to assess is whether a state has an obligation to actively remove its no longer functional space objects or, at least, to consent to their removal by other states. Article VIII OST clearly provides that the state of registry has exclusive jurisdiction over its own space objects and that the permanence of an object in space does not affect its ownership. Therefore, states should have an obligation not to interfere with the space objects of other states, regardless of whether they are functional or not.[123]

In virtue of Article IX OST, other states should first of all request consultations and eventually obtain consent to remove an object. At the same time, a duty can be identified for the launching state to not arbitrarily withhold its consent. Indeed, non-functional satellites occupy valuable orbital positions that could be used by other states. Therefore, arbitrary refusal by a state to remove its non-functional objects or at least to give its consent for them to be removed by other states constitutes abuse of the freedoms guaranteed by Article I and a violation of the due regard principle in Article IX.[124] Since a mere containment approach will soon no longer be sufficient to meet the preservation needs of the space environment, active removal or consent to removal are arguably the only 'appropriate measures' to avoid harmful contamination under Article IX.

[119]See *infra* in the text.

[120]Small satellites currently lack on-board propulsion systems and are therefore unable to voluntarily change their trajectories or perform de-orbiting procedures. They are launched piggyback and only the state procuring the launch of the primary payload is able to select the destination orbit. Technological development will enable these technical obstacles to be overcome because launch vehicles dedicated to small satellites will soon be available. Therefore, it will be possible to plan their injection into an orbit from which natural decay would be possible. On the legal challenges posed by small (and micro) satellites see P. Rosher and A. Shaw, 'Micro Satellites: The Smaller the Satellites, the Bigger the Challenges?', (2016) 41 *Air and Space Law* 311–28.

[121]Art. 40 of the Decree on Technical Regulation issued on 31 March 2011 pursuant to Act no. 2009-643 of 9 June 2009.

[122]All these aspects, namely the existence of a minimum de-orbiting capability and the characteristic of the selected orbit, should be considered in the EIA. See *supra* Section 6.

[123]G. Chung suggests that legal control and jurisdiction over registered space objects cease to exist when there is an 'expressed' or 'implied' act of abandonment, with the consequence that other states could unilaterally remove those objects: G. Chung, 'Jurisdiction and Control Aspects of Space Debris Removal', in A. Froehlich (ed.), *Space Security and Legal Aspects of Active Debris Removal* (2019), at 41. Caution should nonetheless be exercised before drawing the conclusion that a space object is a *res derelicta* from an 'implied' act of abandonment. This option could easily lead to abuse.

[124]The lawfulness of keeping non-functional satellites in orbit has therefore been questioned by a number of eminent space law scholars. M. Williams, *Space Debris and International Law*, Proceedings of the 38th Colloquium on the Law of Outer Space, 1995, at 66: 'it is to be wondered whether inactive satellites are complying with the requirements of Article I of the 1967 Space Treaty, particularly the 'benefit and interest of all countries' and 'freedom of scientific investigation'. See also IAA Cosmic Study, Space Debris Environment Remediation, 2011, at 63.

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The above is all the more true if non-functional objects are situated in areas particularly protected due to unrepeatability of their characteristics.[125] Much like paper satellites, a refusal would also contravene some of the most fundamental principles underlying the ITU regime.[126] After all, despite their differences, the space regimes installed by the UN treaties and the ITU instruments work towards the same end: both aim to ensure the actual and efficient exploration and use of outer space and its natural resources by states and their nationals in order to safeguard the corresponding rights of other users to engage in similar space undertakings.

Article 5, paragraph 4 of the Rescue and Return Agreement represents a further suitable legal basis supporting the existence of an obligation to actively remove space debris or to give consent for it to be removed, at least when it is 'of a hazardous or deleterious nature'.[127] Under this Article, a contracting party which has:

> reason to believe that a space object or its component parts discovered in territory under its jurisdiction, *or recovered by it elsewhere*, is of a hazardous or deleterious nature may so notify the launching authority, which shall immediately take effective steps, under the direction and control of the said Contracting Party, to eliminate possible danger of harm.[128]

Such 'effective steps' cannot but be to remove or, when the launching state does not have at its disposal the necessary technology, not to arbitrarily refuse to accept the removal of such space objects.

Neither the OST nor the Rescue and Return Agreement specify what remedies are available if a state fails to eliminate possible danger of harm and at the same time arbitrarily refuses to accept the removal of its non-functional satellite by other states. Of course, when a refusal by a state determines a breach of its obligations it will be held responsible. Moreover, since the obligations relating to the preservation of the space environment have an *erga omnes* character, any state is entitled to invoke the responsibility of the polluting state even if it is not directly affected by the breach.[129] Nevertheless, this obviously does not mean that other states have a right to remove a non-functional object without the consent of its state. What is certain is that if consent to remove is not given and the requirements of necessity are met a state could invoke this justification and unilaterally remove another state's space debris, for instance when a potential collision threatens the functionality of its space object, the safety of its manned spaceflight or the safety of the population on the ground.[130]

11. Final remarks

The existing legal framework applicable to space debris has its limits. Article IX solely considers adverse changes in the Earth's environment resulting from the introduction of 'extra-terrestrial

[125]In the sense that a customary norm obliging to de-orbit no longer functional objects already exists: Martin, *supra* note 25, at 35–6.

[126]The expression 'paper satellites' refers to the practice of registering satellites without actually launching them, merely informed by an intention to hog valuable space resources for future purposes. The ITU promulgated intrusive measures to combat this gross subversion of the ITU registration procedure, such as the cancellation of an unused entry. Non-functional satellites are likewise a waste of valuable resources. They serve no other function but to deprive access to space by other users.

[127]Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, UN Doc. A/RES/2345(XXII) (1967). As of 1 January 2020, it is binding on 98 states.

[128]Emphasis added.

[129]See *supra* note 93.

[130]H. DeSaussure goes even farther and focuses on the due regard principle contained in Article IX and on an analogy with derelicts at sea to derive a right for other states to remove a threatening space object: H. De Saussure, 'An International Right to Reorbit Earth Threatening Satellites', (1978) 3 AASL 383–94, at 390–4.

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matter', while the possibility that adverse changes could result from the re-entry of man-made debris is not even considered and deserves greater attention. The UNCOPUOS Guidelines correctly recognize that 'due consideration should be given to ensuring that debris that survives to reach the surface of the Earth does not pose an undue risk to people or property, including through environmental pollution caused by hazardous substances'.[131]

It has been pointed out that, from a combined reading of Article I and Article IX OST and Article 5 of the Rescue and Return Agreement, the existence of an obligation can be deduced on the state parties to these treaties to actively remove their space debris or at least to consent to its removal by other states. Nevertheless, reasons of legal certainty would suggest adopting an explicit binding provision stating an obligation on operating states to actively remove their no longer functional space objects coupled with a mechanism to react in cases of arbitrary refusal.[132] Moreover, Article 5 of the Rescue and Return Agreement qualifies the object to be removed as being 'of a hazardous or deleterious nature'. Unless one accepts that any space debris is hazardous or deleterious, this restrictive requirement could severely limit the application of the rule to space debris. A new binding provision could be modelled on Article 60, paragraph 3 of the Montego Bay Convention, which requires states to remove any installations or structures which are abandoned or disused 'to ensure safety of navigation' in the exclusive economic zone with no further requirements.[133]

Then, in consideration of the fact that it is in most cases impossible to trace a fragment back to the object from which it originates and to identify a responsible and liable state, the proposal to establish an 'International Outer Space Clean-Up Fund' aimed at both providing compensation for damage caused by unidentifiable space debris and paying the cost of its removal before damage is done could be renewed. Each state should contribute to the Fund according to its past and actual use of the space 'environment' and a useful indicator for this purpose could be the profit made from or the cost involved in launches. Last but not least, a specific prohibition of anti-satellite weapon testing would be needed as it is the most concerning action in the field of debris proliferation.

Time will tell whether these proposals will be implemented. However, one point is certain. Regardless of any further legal development, the basic provisions against debris proliferation are already at hand in the Outer Space Treaty. Against the common interpretation of Article IX OST, I have tried to demonstrate that the final aim – to avoid harmful contamination and interference with the space activity of other states – cannot be the object of a reductionist interpretation. The obligations in Article IX OST likewise cannot be downgraded to a general pledge or a mere political commitment. Although Article IX OST admittedly does not specify which 'appropriate' measures to adopt in order to avoid harmful contamination of outer space and celestial bodies, the rule is supplemented by general international law rules and by the UNCOPUOS Guidelines, which provide for the application by states of the most advanced debris mitigation standards along the entire life cycle of a space object. The relationship between the obligation to carry out an EIA and the obligation to notify and consult other states has consistently been ascertained. As these are obligations of conduct, compliance with them does not depend on the level of a state's development or of the financial resources at its disposal. The technical standards at hand, and consequently the required level of due diligence, may admittedly vary from state to state, but the fact that a state does not have the most advanced technology at its disposal does not equate to a licence for recklessness. On the contrary, the lower the available technical

[131]UNCOPUOS Guideline 6; see also Long-term sustainability Guideline B.9 and D.2 para. 4.

[132]On the need for a specific provision with this purpose see also Pedrazzi, *supra* note 30, at 117. On the need to strengthen the non-binding recommendation that advises ITU members to remove their disused satellites from orbit at the end of their lifetimes into a binding enforceable obligation see Man, *supra* note 28, at 234.

[133]See also the detailed 2007 Nairobi International Convention on the Removal of Wrecks.

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standards, the greater the potential for the activity to be harmful, and the more stringent the obligations to perform an EIA, to notify and to consult become.

Fruitfully combined with other rules and standards, Article IX OST already provides a set of important limits and constraints for states carrying out space activities. Failure to co-operate and minimize the risk of harmful contamination may have legal implications in terms of responsibility, and even liability in cases where these risks materialize. Consequently, it is difficult to deny that a refusal by space powers to even start any consultation in cases of potential harmful contamination/interference – no matter how serious or visible this might be to public opinion – constitutes a material breach of Article IX OST. This is particularly true in the deplorable case that a state intends to perform an anti-satellite weapon test. International lawyers would render a disservice to the universal human cause of space exploration and use if – merely focusing on the general character of the OST provisions – they tried to demolish the limits already contained in them.

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