Planetary Protection - Legal Issues [1]

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Abstract

The object of the present paper is to give an overview of the current international and national regulation applicable to planetary protection. As far as international space law is concerned, most of the obligations imposed on States are contained in the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. Among these obligations, the most relevant provision concerning planetary protection is Article IX according to which States shall pursue studies and conduct exploration of outer space so as to avoid its harmful contamination as well as adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter. Consequently, COSPAR and NASA have adopted planetary protection standards for missions conducted in outer space. Environmental law may also have an impact on planetary protection regulations, since most of its applicable provisions focus on the potential effects that concerned activities may have, regardless of the nature of the activity. These provisions may therefore apply to space activities. The prevention principle may be regarded as one of the most important of them. According to this principle, States have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Introduction

In the Year 2003, the space community has shown a stronger interest in Planet Mars. The NASA Mars Exploration Rover Mission programme has lead to the launch of Spirit on 10 June 2003 and of Opportunity on 7 July 2003. The first rover is intended to land in January 2004. On 2 June 2003, the European Mars Express space probe was placed in a trajectory that will take it to Mars - getting there in late December 2003. While these missions will try to answer to some basic scientific questions such as the existence of life on Mars, presently or in the past, the issue of planetary protection has been raised again by space agencies, associations and universities. Planetary protection is a policy concerning the regulations against human contamination of celestial bodies - the so-called "forward contamination", and the contamination of the Earth by spacecrafts and space crews, possibly bearers of extraterrestrial micro-organisms returning from outer space, the so-called "back contamination". The rules that constitute a legal basis for imposing obligations on States in terms of planetary

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protection derive from two main branches of law: space law (Part I) and environmental law (Part II).

I. Space law principles

Some provisions of the Outer Space Treaty and of the Moon Agreement have a direct impact on planetary protection policies (A). However, the over-all effect of these treaties provisions is minimal since they provide no specific standards and no official method for clarifying issues and monitoring activities. That is why these obligations will need some detailed application policies, like the COSPAR guidelines or the NASA policy (B), to become really effective.

A. United Nations Treaties

Article IX - sentence two - of the 1967 Treaty on principles governing the activities of States in the exploration and use of outer space, including the Moon and other celestial bodies[1] (the Outer Space Treaty) constitutes the primary statement of international law, which has tended to protect and preserve the environmental integrity of Earth and space from the initial period of interplanetary exploration. According to the article: "States Parties shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, when necessary, adopt appropriate measures for this purpose".

The rule only refers to activities for the investigation and exploration of outer space, but the scope of application of this sentence could be interpreted as a general principle of space law incorporating all space activities including commercial ones. For the purpose of avoiding negative effects to the environment, Article IX tends to limit the freedom of outer space principle, as stated in article I of the Outer Space Treaty. The question must however be asked immediately what the key expression "harmful contamination" is supposed to mean and how it has to be interpreted? There are many different interpretations of "contamination" in the space law literature but we should use the COSPAR guidelines that restrict the content of the expression to "biological contamination". The restrictive interpretation of the term "contamination" also results from the Preparatory Works of the Outer Space Treaty. We shall notice that Article XI of the Outer Space Treaty provides for greater protection for the Moon and other celestial bodies than for the Earth. Indeed, if "harmful contamination" should be avoided in outer space, including the Moon and other celestial bodies, the Earth is only protected against "adverse changes" in its environment. The issue of back contamination is less important in this article and will mainly be taken up by general international environmental conventions.

Article 7.1 of the 1979 Agreement concerning the activities of States on the Moon and other celestial bodies[2] (the Moon agreement) represents the second main rule dealing with planetary protection. According to the text: "In exploring and using the Moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States parties shall also take measures to avoid harmfully affecting the environment of the Earth through the introduction of extraterrestrial matters or otherwise".

Under the Moon agreement, States shall also therefore take appropriate measures for all missions to prevent disruption of the natural environs. As Article IX of the Outer Space Treaty, this provision is extremely well intentioned but avoids the important definition of "harmful". However, even if this principle is extremely broad, like in Article IX of the Outer Space Treaty, Article 7.2 of the Moon Agreement establishes a follow-up mechanism since States have to inform the Secretary General of the United Nations of the measures adopted by States in order to respect planetary protection principle.

B. Detailed application policies

The 2002 COSPAR Planetary Protection Policy represents a statement on planetary protection for the reference of space faring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration, and providing accepted guidelines in this area to guide compliance with the wording of the Outer Space Treaty and other relevant international agreements. These principles do not constitute binding law. They may however be applied by States on a political voluntary basis, and shall therefore be regarded as so-called soft law, since COSPAR plays an important role as the standard-setting international organisation in the area of planetary protection. The COSPAR policy on planetary protection makes reference to Article IX of the Outer Space Treaty. Taking this provision into account, the COSPAR accepts that for certain space mission/target body combinations, controls on contamination shall be imposed in accordance with a specified range of requirements. The COSPAR policy makes distinction between five categories of target body/mission type combinations, with the corresponding protection regimes. These categories and regimes are reproduced in Annex of this document. COSPAR further recommends its members to provide information within a certain period about the procedures and computations used for planetary protection for each flight, in order to make reports available to the public and delivered to the Secretary-General of the United Nations. The required content of the reports is the following:

- The estimated biological burden at launch, the methods used to obtain the estimate (e.g., assay techniques applied to spacecraft or a proxy), and the statistical uncertainty in the estimate.
- The probable composition (identification) of the biological burden for Category IV missions, and for Category V "restricted Earth return" missions.
- Methods used to control the biological burden, decontaminate and/or sterilize the space flight hardware.
- The organic inventory of all impacting or landed spacecraft or spacecraft-components, for quantities exceeding 1 kg.
- Intended minimum distance from the surface of the target body for launched components, for those vehicles not intended to land on the body.

NASA has also adopted a Planetary Protection policy in order to implement the United Nations Treaties. In 1958 NASA adopted a resolution expressing the policy that planetary protection should be conducted so as to prevent contamination of celestial objects. In 1959, NASA adopted a stringent policy concerning planetary protection, to the effect of "payloads which might impact a celestial body must be sterilised before launching". This policy was strict, severe and inviolate. All payloads had to be sterilised. In 1964, the COSPAR published a recommendation called "Planetary Quarantine

Requirements" (PQR)[3]. NASA adopted the PQR and modified its original policy of sterilisation by implementing series of management instructions and policy directives. The new policy required that interplanetary missions had to be conducted in order to restrict the probability of contamination of the target body in prescribed limits. This probability was determined by a mathematical formula. The planetary protection policies were modified again in 1994, in anticipation of the exploratory missions to Mars. This revision to the policy was specifically about the utilisation of decontamination and cleanliness control everytime the mission objectives included life-detection experiments. The most recent revision by NASA to the planetary protection policy became effective in 1999 on the basis of the NASA Policy Directive on Biological Contamination Control for Outbound and Inbound Planetary Spacecraft[4]. The objective of this document is to implement the Outer Space Treaty as well COSPAR guidelines on planetary protection through national regulation. The policy directive applies to NASA Headquarters and NASA Centers, including Component Facilities, and to NASA contractors where specified by contract. The provisions of the directive cover all space flight missions which may intentionally or unintentionally carry Earth organisms and organic constituents to the planets or other solar system bodies, and any mission employing spacecraft which are intended to return to Earth and/or its biosphere from extraterrestrial targets of exploration. The policy directive enumerates the Associate Administrator for Space Science's responsibilities as far as planetary protection is concerned, namely: maintaining the required activities in support of the planetary protection policy at NASA Headquarters; assuring that the research and technology activities required to implement the planetary protection policy are conducted; monitoring space flight missions as necessary to meet the requirements for planetary protection certification. The Planetary Protection Officer is responsible for implementing NASA planetary protection policy, as stated in the directive. To that extent, the role notably involves prescribing standards applicable to all NASA missions, as detailed in the directive. In addition, it is foreseen that specific constraints imposed on spacecraft involved in solar system exploration will depend on the nature of the mission and the identity of the target body or bodies, in accordance with current scientific knowledge about the target bodies. The most likely constraints on missions of concern will be a requirement to reduce the biological contamination of the spacecraft, coupled with constraints on spacecraft operating procedures, an inventory of organic constituents of the spacecraft and organic samples, and restrictions on the handling and methods by which extraterrestrial samples are returned to Earth. In the majority of missions, there will also be a requirement to document spacecraft flyby operations, spacecraft impact potential, and the location of landings or impact points of spacecraft on planetary surfaces or other bodies.

II. Environmental Law Principles

Even though international environmental conventions do not specifically address space pollution and the contamination of celestial bodies, they may be applied to the issue of back contamination. Indeed, the hypothesis of pollution described in these conventions can in most cases apply to hypothesis of contamination due to matter imported from space or from a celestial body. General principles of environmental law, namely prevention and precautionary principles (A), also find application on the issue of planetary protection (B).

A. General principles of environmental law - Prevention and Precautionary principles

The International Court of Justice mentioned in 1997 the absolute need to prevent environmental damage, due to the possibility of irreversible effects[5]. The so-called "prevention principle" gives birth to a certain number of general obligations for States, that are notably implemented through the precautionary principle. Two international texts must be underlined as far as these principles are concerned: the 1972 Declaration of the United Nations Conference on the Human Environment[6] (the Stockholm Declaration) and the 1992 Declaration of the United Nations Conference on Environment and Development[7] (the Rio Declaration).

The prevention principle, as stated by the Stockholm declaration, applies to all activities within States jurisdiction that may cause damage to the environment. According to Principle 21: "States have [...] the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction". The so-called prevention principle makes no distinction between the activities concerned, as soon as these activities cause damage to the environment. It shall therefore be regarded as a sound legal basis for planetary protection policies. In addition, this principle may find application for both back and forward contamination, since not only damage to the environment of other States but also damage to areas beyond the limits of national jurisdiction is concerned.

Principle 2 of the Rio Declaration strictly reproduces in similar wording of the above mentioned Principle 21 of the Stockholm Declaration. In addition, and for the above-mentioned purpose of preventing damage caused to the environment of other States (...), Principle 15 of the Rio Declaration has for the first time explicitly recognised the Precautionary Principle: "In order to protect the environment, the precautionary approach should be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". Should it be regarded as binding on a customary basis, this principle could conduct States involved in space missions to take effective measures in order to prevent environmental degradation due to these missions.

The stated principles are contained in declarations, and shall therefore be regarded as soft law. The prevention principle, as stated by Principle 21 of the Stockholm Declaration and by Article 2 of the Rio Declaration, shall however be regarded as binding on a customary basis.

B. Specific environmental treaties applicable to planetary protection

Two specific environmental treaties may be specially relevant for planetary protection: the 1979 Convention on Long-range Transboundary Air Pollution[8] and the 1992 Convention on the Transboundary Effects of Industrial Accidents[9].

The 1979 Convention on Long-range Transboundary Air Pollution tends to tackle the possible adverse effects of transboundary air pollution. Article 1 of the convention defines "air pollution" as the introduction by man of substances into the air resulting in deleterious effects of such a nature as to endanger human health, harm living resources. As nothing in the convention is specified about the origin of the contaminating substance, it may have been imported from space or a celestial body. For the purpose stated by the

convention, the parties have to improve their research and development in several fields such as instrumentation for measuring pollution, education and training programs or technologies for reducing the emissions of air pollutants. The most important obligation relies in the exchange of information between States parties: should a State party to the convention be affected by air pollution, consultations have to be held with other States. Moreover, States have to exchange data about their level of pollution and their way to improve it, as well as about their activities that might result in transboundary air pollution. Therefore, should a State party lead an activity in outer space or on a celestial body implying an unknown biological matter which might cause contamination on Earth, other States will have to be informed in accordance with the provisions of the convention. No specific responsibility regime is however provided by the convention concerning such activities. States parties responsibility may nevertheless be engaged on the basis of the general regime of international responsibility, as described above.

The 1992 Convention on the Transboundary Effects of the Industrial Accidents tends to tackle the harmful consequences of industrial accidents for the environment of the Earth. For the purpose of this convention, industrial accident means an event resulting from an uncontrolled development in the course of any activity involving hazardous substances. It does not apply to nuclear and radiological accidents, dam failures land based transport but may have an of space missions, if the latter involve hazardous substances that can possibly contaminate the environment. According to the convention, States have to take preventive measures to identify the risk of industrial accident and try to reduce pollution in this hypothesis. This obligation is a strong basis for a binding cleanliness and decontamination of spacecrafts containing hazardous extraterrestrial matters. States must give information to the public in case of industrial accident with contaminating consequences and inform other States that might be affected by this contamination. Moreover, States have an obligation to exchange their contamination prevention technologies, which could lead to an international cooperation program to improve spacecraft cleanliness technologies.

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Annex

Cospar Planetary Protection Policy (20 October 2002) – Extract

Category I includes any mission to a target body which is not of direct interest for understanding the process of chemical evolution or the origin of life. No protection of such bodies is warranted and no planetary protection requirements are imposed by this policy.

Category II missions comprise all types of missions to those target bodies where there is significant interest relative to the process of chemical evolution and the origin of life, but where there is only a remote chance that contamination carried by a spacecraft could jeopardize future exploration. The requirements are for simple documentation only. Preparation of a short planetary protection plan is required for these flight projects primarily to outline intended or potential impact targets, brief Pre- and Post-launch analyses detailing impact strategies, and a Post-encounter and End-of-Mission Report which will provide the location of impact if such an event occurs. Solar system bodies considered to be classified as Category II are listed in the Appendix to this document.

Category III missions comprise certain types of missions (mostly flyby and orbiter) to a target body of chemical evolution and/or origin of life interest or for which scientific opinion provides a significant chance of contamination which could jeopardize a future biological experiment. Requirements will consist of documentation (more involved than Category II) and some implementing procedures, including trajectory biasing, the use of cleanrooms during spacecraft assembly and testing, and possibly bioburden reduction. Although no impact is intended for Category III missions, an inventory of bulk constituent organics is required if the probability of impact is significant. Category III specifications for selected solar system bodies are set forth in the Appendix to this document. Solar system bodies considered to be classified as Category III also are listed in the Appendix.

Category IV missions comprise certain types of missions (mostly probe and lander) to a target body of chemical evolution and/or origin of life interest or for which scientific opinion provides a significant chance of contamination which could jeopardize future biological experiments. Requirements imposed include rather detailed documentation (more involved than Category III), including a bioassay to enumerate the bioburden, a probability of contamination analysis, an inventory of the bulk constituent organics and an increased number of implementing procedures. The implementing procedures required may include trajectory biasing, cleanrooms, bioload reduction, possible partial sterilization of the direct contact hardware and a bioshield for that hardware. Generally, the requirements and compliance are similar to Viking, with the exception of complete lander/probe

sterilization. Category IV specifications for selected solar system bodies are set forth in the Appendix to this document. Solar system bodies considered to be classified as Category IV also are listed in the Appendix.

Category V missions comprise all Earth-return missions. The concern for these missions is the protection of the terrestrial system, the Earth and the Moon. (The Moon must be protected from back contamination to retain freedom from planetary protection requirements on Earth-Moon travel.) For solar system bodies deemed by scientific opinion to have no indigenous life forms, a subcategory "unrestricted Earth return" is defined. Missions in this subcategory have planetary protection requirements on the outbound phase only, corresponding to the category of that phase (typically Category I or II). For all other Category V missions, in a subcategory defined as "restricted Earth return," the highest degree of concern is expressed by the absolute prohibition of destructive impact upon return, the need for containment throughout the return phase of all returned hardware which directly contacted the target body or unsterilized material from the body, and the need for containment of any unsterilized sample collected and returned to Earth. Post-mission, there is a need to conduct timely analyses of the unsterilized sample collected and returned to Earth, under strict containment, and using the most sensitive techniques. If any sign of the existence of a nonterrestrial replicating entity is found, the returned sample must remain contained unless treated by an effective sterilizing procedure. Category V concerns are reflected in requirements that encompass those of Category IV plus a continuing monitoring of project activities, studies and research (i.e., in sterilization procedures and containment techniques).

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[1] 610 *UNTS* 205.
[2] 1363 *UNTS* 3.
[3] COSPAR res. 26, COSPAR infor. bull. At annex 4 (1964), fifth international space science symposium, Florence Italy.
[4] 42 *U.S.C.* 2473(c)(1), Section 203(c)(1) of the National Aeronautics and Space Act of 1958, as amended - Expiration date : 19 February 2004.
[5] ICJ, 25 September 1997, *Gabcikovo-Nagimaros Project*, par. 140.
[6] 11 *ILM* 1416 (1972)
[7] A/CONF.151/26 Vol.I.
[8] 1302 *UNTS* 217.
[9] 31 *ILM* 1330.