

These “controls” are organized according to five categories, ranging from simple probe flyby missions to Earth return missions. For the sake of brevity, this article will only address category V (Earth return) missions, seeing as they have the greatest capacity to directly affect Earth’s environment. Within category V are two sub-categories: “unrestricted” and “restricted Earth return.”⁶⁷ “Unrestricted Earth return” is reserved for “solar system bodies deemed by scientific opinion to have no indigenous life forms . . . [and] have planetary protection requirements on the outbound phase only.”⁶⁸ On the other hand, “restricted Earth return” demands “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.”⁶⁹ Furthermore, “[i]f 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.”⁷⁰

In order to distinguish between restricted and unrestricted Earth return missions, the COSPAR Guidelines ask a series of questions concerning the mission’s target celestial body: are liquid water, “metabolically useful energy sources,” or life supporting organic matter present, has the target body never experienced sufficient temperatures or radiation to sterilize possible life forms, and has the Earth never been exposed to meteorites of “material equivalent to a sample returned from the target body?”⁷¹ If the answer to any of these questions is yes, the mission must follow procedures for a “restricted Earth return.”⁷²

To ensure compliance with these guidelines, COSPAR recommends, that for each individual mission, States provide detailed information concerning their “procedures and computations used for planetary protection,” including the estimated bioburden at launch, probable composition of bioburden, methods used to control biobur-

⁶⁷ *Id.* at 2.

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ *Id.*

⁷¹ *Id.* at 9.

⁷² *Id.*

den, the organic inventory of all impacting or landed spacecraft, intended minimum distance from the target body, orbital parameters, end of mission disposition of the spacecraft and its components, and the “use of the best available clean room technology, comparable with that employed for the Viking missions, for all missions to the outer planets and their satellites.”⁷³

Furthermore, if during the course of a category V mission circumstances change so as to affect the safe return of samples from a target body, “the sample to be returned shall be abandoned, and if already collected the spacecraft carrying the sample must not be allowed to return to the Earth or the Moon.”⁷⁴

C. NASA’s Planetary Protection Guidelines

As previously described, the world’s major space agencies, including NASA, have adopted COSPAR’s guidelines as their own, expanding them to ensure planetary protection and contamination avoidance for every mission.⁷⁵ In a report on planetary protection procedures by the Jet Propulsion Laboratory (JPL), NASA confirms the probability of extraterrestrial life and the need to adequately prepare for the challenge of interacting with a vastly unexplored space environment;

In the last twenty years, our exploration of the solar system has revealed previously unknown extraterrestrial environments, both current and ancient, in which life could conceivably survive and even thrive. Simultaneously, we have a deeper understanding of the diversity of habitable environments on our own planet, supporting the opportunistic nature of living systems able to exploit nearly any energetically favorable chemistry. In addition, sample return from potentially habitable planetary environments presents new challenges as we face an increased need for containment systems that protect the native biosphere. These goals—protecting the scientific integrity of sites on planetary bodies for future research, as well as

⁷³ *Id.* at 3. NASA defines “Bioburden” as the “abundance of microorganisms” on spacecraft, spacecraft components, or within cleanroom facilities, see *Mission Requirements*, NASA: OFFICE OF PLANETARY PROTECTION, <https://planetaryprotection.arc.nasa.gov/requirements> (last visited Nov. 10, 2016) [hereinafter NASA Mission Requirements].

⁷⁴ *Id.* at 5.

⁷⁵ JPL Report, *Supra* note 65.

safely returning extraterrestrial samples to Earth—jointly motivate the field of planetary protection. Planetary protection has policy elements, as it encompasses international agreements governing extraterrestrial research, as well as implementation challenges in the procedures developed to satisfy these top-level requirements. This dual policy-implementation nature of planetary protection makes technology-planning exercises particularly formidable.⁷⁶

The JPL Report promotes implementing COSPAR's planetary protection policies from the ground up, integrating contamination control measures into the very fabric of systems engineering, personnel education/training, and mission planning,⁷⁷

[T]he elements of contamination control and planetary protection that are critical to mission planning, science, and hardware design must be a fundamental part of the systems engineering and must be addressed at the earliest stages of the mission to ensure proper flow-down of requirements and cost-effective mission planning. An adequate approved materials/parts list that can accommodate both contamination control and planetary protection considerations should be developed. Integrated modeling tools should be developed to aid systems engineers and designers for future work, particularly in the form of risk assessments for forward- and back-contamination.⁷⁸

Although far too extensive to address in depth within this article, the full scope of NASA's planetary protection guidelines include exhaustive specifications for clean rooms and microbial barriers, object cleaning and sterilization methods, methods for the prevention of recontamination, bioburden assay methods, and methods for preventing the impact and contamination of solar system bodies.⁷⁹ The process begins as the very first pieces of a space object are assembled and continues throughout its eventual mission and (possible) return to Earth.

⁷⁶ JPL Report, *supra* note 65, at 4.

⁷⁷ *Id.* at 1-2.

⁷⁸ *Id.* at 2.

⁷⁹ NASA Mission Requirements, *supra* note 74.

D. Planetary Protection as a Facet of International Law

Although the above mentioned processes are only a few of the specifications included in the Guidelines, these alone would provide a much needed safety buffer for space-resource utilization missions conducted by private entities under the CSLCA. It is this author's position that COSPAR's Guidelines, as currently implemented by NASA, should be integrated into the CSLCA as mandatory requirements for every "mission" conducted under the authority of the act. However, even if not expressly integrated, the Guidelines have arguably become part of customary international law. The Statute of the International Court of Justice (ICJ) establishes that international customary law is "evidenced by a general practice that is accepted as law."⁸⁰ This two prong system for proving something is customary—showing both state practice and *opinio juris*—is further explained in *Nicaragua v. U.S.*, where the ICJ held that,

for a new customary rule to be formed, not only must the acts concerned "amount to a settled practice," but they must be accompanied by the opinion juris *sive necessitatis*. Either the States taking such action or other States in a position to react to it, must have behaved so that their conduct is "evidence of a belief that this practice is rendered obligatory by the existence of a rule of law requiring it."⁸¹

As previously shown, the COSPAR Guidelines were drafted by representatives of over forty space-faring nations and thirteen international scientific unions as a direct response to the legal obligations imposed by article IX. Furthermore, they are implemented (almost universally) as state practice by the vast majority of space-faring nations.⁸²

Even if the COSPAR Guidelines were not backed by state practice or *opinio juris*, the precautionary principle of international law alone would necessitate further clarification and/or amendments to the CSLCA. The precautionary principle is a "guiding principle" in international law, "[i]t's purpose is to encourage—perhaps even

⁸⁰ Statute of the International Court of Justice art. 38, 59 Stat. 1031.

⁸¹ *Case Concerning Military and Paramilitary Activities in and Against Nicaragua (Nicaragua v. U.S.)*, 1986 I.C.J. 4. 108-09 (June 27), quoting *North Sea Continental Shelf Cases (F.R.G. v. Den./F.R.G. v. Neth.)*, 1969 I.C.J. 3, 44 (Feb. 20).

⁸² *Members*, COSPAR, *supra*, note 64.