NPI 8020.7
NPD 8020.7G

NASA Policy Instruction
NASA Policy on Planetary Protection Requirements for Human Extraterrestrial Missions

1. Background

In May 2012, the Planetary Protection Subcommittee of the NASA Advisory Council (NAC) Science Committee formulated a recommendation that NASA Procedural Requirements (NPR) be developed for planetary protection on human missions under NASA Policy Directive (NPD) 8020.7, "Biological Contamination Control for Outbound and Inbound Planetary Spacecraft," as a parallel document to NPR 8020.12, "Planetary Protection Provisions for Robotic Extraterrestrial Missions." This recommendation was endorsed by the full NAC and forwarded to the Administrator in November 2012, and was agreed upon by the NASA Administrator in a letter dated March 8, 2013.

There is presently insufficient scientific and technological knowledge to establish detailed requirements and specifications to enable NASA to incorporate planetary protection into the development of crewed spacecraft and missions. Thus, this NASA Policy Instruction (NPI) establishes policy guidelines and describes the approach for obtaining the scientific information and developing the technologies and procedures over the next few years that are needed to draft an NPR for crewed planetary missions.

2. History

Even before Neil Armstrong's boot first touched the Moon, NASA has been concerned with the protection of Earth and its inhabitants from extraterrestrial life forms returned from inbound spacecraft. In order to protect against possible disease or other health issues incurred upon Earth's inhabitants, procedures were created to prevent such back contamination. Each of the early Apollo astronauts endured 21 days of quarantine upon their return to Earth, as determined by the Interagency Committee on Back-Contamination based on the fact that most terrestrial disease agents were capable of invading a host and causing evident disease symptoms within 21 days after exposure of the host. In addition to protecting against back-contamination, NASA is also dedicated to the preservation of any native extraterrestrial life forms and maintaining the scientific purity of the celestial bodies to which NASA travels. Contamination by biological material from Earth could make it impossible to determine if life was present before humans visited.

Since the end of the Apollo era, robotic missions have served as humankind's emissary to other solar system bodies, including the Sun, planets and small solar system objects. As an example, launched November 2011, the Mars Science Laboratory's (MSL) Curiosity rover was designed to assess whether Mars ever had a habitable environment, able to support small life forms called microbes. Planetary protection requirements called for the entire MSL flight system to launch

with no more than 500,000 bacterial spores. This was accomplished mainly through the careful maintenance of clean room protocols, periodic cleaning of spacecraft surfaces with alcohol wipes, and dry heat treatment of some spacecraft parts.

Space exploration is now conducted by the space agencies of nations around the globe. The International Council for Science, a nongovernmental organization, established the Committee on Space Research (COSPAR) in 1958 as an interdisciplinary scientific body concerned with the progress on an international scale of all kinds of scientific investigations carried out with space vehicles, rockets and balloons.

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which established the basic legal framework of international space law, entered into force in 1967. Article IX of this treaty provides in relevant part, that:

> "States Parties to the Treaty shall pursue studies of outer space, …, and conduct exploration of them so as to avoid their harmful contamination ["forward contamination"] and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter ["back contamination"] and, where necessary, shall adopt appropriate measures for this purpose."

COSPAR established the first planetary protection guidelines for robotic missions in 2002. While not legally binding, COSPAR's Planetary Protection Policy is:

> "for the reference of spacefaring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration, and to provide accepted guidelines in this area to guide compliance with [Article IX of the 1967 Outer Space Treaty] and other relevant international agreements."

In March 2011, amendments to the COSPAR Planetary Protection Policy were approved by the Bureau and Council, World Space Council to include Principles and Guidelines for Human Missions to Mars (see Attachment A).

As NASA, in collaboration with our international partners, prepares to return humans beyond low-Earth orbit to explore the solar system and search for signs of life beyond Earth, it is critical that NASA guidelines be developed for crewed missions. A key NASA international partner, the European Space Agency (ESA) adheres to COSPAR Planetary Protection Policy for both crewed and robotic missions, as expressed in ESA/C(2007)112.

3. Policy Guidance

NASA adheres to the COSPAR guidelines. NPD 8020.7G *(Biological Contamination Control for Outbound and Inbound Planetary Spacecraft [expires February 19, 2018]),* quoting the COSPAR policy statement, requires Agency compliance with COSPAR policy regarding biological contamination control for outbound and inbound planetary spacecraft, covering **all**

space flight missions[1] which may intentionally or unintentionally carry Earth organisms and organic constituents to the planets or other solar system bodies, including spacecraft which are intended to return to Earth and/or its biosphere from extraterrestrial targets of exploration. All missions in which NASA will participate are required to adhere to NPD 8020.7G and to be consistent with the COSPAR policy and guidelines for human missions (Attachment A).

4. Studies

Detailed studies must be conducted in order to obtain information critical to developing planetary protection requirements for human spaceflight missions. NASA will gather community input to determine the topics that should be studied; for example:

1) Developing capabilities to comprehensively monitor the microbial communities associated with human systems and evaluate changes over time;

2) Developing technologies for minimizing/mitigating contamination release, including but not limited to closed-loop systems; cleaning/re-cleaning capabilities; support systems that minimize contact of humans with the environment of Mars and other solar system destinations;

3) Understanding environmental processes on Mars and other solar system destinations that would contribute to transport and sterilization of organisms released by human activity.

5. Path Forward

NASA shall utilize the following roadmap to develop the necessary understanding of the scientific and technological basis to take sufficient steps to ensure planetary protection and then to develop an NPR setting forth requirements for planetary protection and carry out the NPR's mandates.

1. Present the required studies report to senior management for approval and commitment of funding, through a Memorandum of Understanding or other documentation.
2. Include sufficient funding for approved planetary protection studies as part of the NASA budget development process, leading to approval of funding for these studies no later than Fiscal Year 2016.
3. Conduct studies and develop planetary protection requirements.
4. Integrate funding for planetary protection requirements into the ongoing budgets of all developing human missions that will come in contact with another celestial body.
5. Develop and formalize NPR for Planetary Protection for Crewed Missions.

In response to the Planetary Protection Subcommittee's recommendation, a cross-disciplinary *ad hoc* team was established that developed this NPI and is responsible for:

[1] Emphasis added; in the title of the NPD, "planetary spacecraft" covers both robotic and human missions.

- Conducting a literature review to identify completed studies and investigations relevant to the development of verifiable planetary protection requirements for human missions;
- Seeking input from scientific and space operations community through a variety of sources, including, a workshop;
- Oversight of the recommended studies and following through on their completion to the development of specific requirements;
- Developing a draft NPR for planetary protection for human spaceflight that includes these specific requirements for mission development and follow the necessary NASA coordination and approval processes to baseline the NPR;
- Coordinating with relevant mission management teams within NASA, to ensure understanding of the requirements in order to achieve compliance.

The team is led by the Human Exploration and Operations Mission Directorate, with the Planetary Protection Officer serving as a technical advisor. Other participants include representatives from the following organizations: Science Mission Directorate, Space Technology Mission Directorate, Office of the General Counsel, Office of the Chief Scientist, Office of the Chief Medical Officer, and Office of International and Interagency Relations. Other organizations may be added as appropriate.

6. References

Attachment A: COSPAR Policy and Guidelines for Human Missions
Attachment B: Letter from NAC Planetary Protection Subcommittee Chair to NAC Science Committee Chair

Attachment A: COSPAR Policy and Guidelines for Human Missions

COSPAR PLANETARY PROTECTION POLICY

(20 October 2002; As Amended to 24 March 2011)

APPROVED BY THE BUREAU AND COUNCIL, WORLD SPACE COUNCIL, HOUSTON, TEXAS, USA
(Prepared by the COSPAR/IAU Workshop on Planetary Protection, 4/02, with updates 10/02; 1/08, 4/09, 12/09, 3/11)

PREAMBLE

Noting that COSPAR has concerned itself with questions of biological contamination and spaceflight since its very inception, and

noting that Article IX of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (also known as the UN Space Treaty of 1967) states that:

> States Parties to the Treaty 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 where necessary, shall adopt appropriate measures for this purpose. (UN 1967)

therefore, COSPAR maintains and promulgates this planetary protection policy for the reference of spacefaring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration, and to provide accepted guidelines in this area to guide compliance with the wording of this UN Space Treaty and other relevant international agreements.

…

APPENDIX: IMPLEMENTATION GUIDELINES AND CATEGORY SPECIFICATIONS FOR INDIVIDUAL TARGET BODIES

…

Principles and Guidelines for Human Missions to Mars

The intent of this planetary protection policy is the same whether a mission to Mars is conducted robotically or with human explorers. Accordingly, planetary protection goals should not be relaxed to accommodate a human mission to Mars. Rather, they become even more directly relevant to such missions—even if specific implementation requirements must differ. General principles include:

- Safeguarding the Earth from potential back contamination is the highest planetary protection priority in Mars exploration.
- The greater capability of human explorers can contribute to the astrobiological exploration of Mars only if human-associated contamination is controlled and understood.
- For a landed mission conducting surface operations, it will not be possible for all human-associated processes and mission operations to be conducted within entirely closed systems.
- Crewmembers exploring Mars, or their support systems, will inevitably be exposed to martian materials.

In accordance with these principles, specific implementation guidelines for human missions to Mars include:

- Human missions will carry microbial populations that will vary in both kind and quantity, and it will not be practicable to specify all aspects of an allowable microbial population or potential contaminants at launch. Once any baseline conditions for launch are established and met, continued monitoring and evaluation of microbes carried by human missions will be required to address both forward and backward contamination concerns.
- A quarantine capability for both the entire crew and for individual crewmembers shall be provided during and after the mission, in case potential contact with a martian life-form occurs.
- A comprehensive planetary protection protocol for human missions should be developed that encompasses both forward and backward contamination concerns, and addresses the combined human and robotic aspects of the mission, including subsurface exploration, sample handling, and the return of the samples and crew to Earth.
- Neither robotic systems nor human activities should contaminate “Special Regions” on Mars, as defined by this COSPAR policy.
- Any uncharacterized martian site should be evaluated by robotic precursors prior to crew access. Information may be obtained by either precursor robotic missions or a robotic component on a human mission.
- Any pristine samples or sampling components from any uncharacterized sites or Special Regions on Mars should be treated according to current planetary protection category V, restricted Earth return, with the proper handling and testing protocols.

- An onboard crewmember should be given primary responsibility for the implementation of planetary protection provisions affecting the crew during the mission.
- Planetary protection requirements for initial human missions should be based on a conservative approach consistent with a lack of knowledge of martian environments and possible life, as well as the performance of human support systems in those environments. Planetary protection requirements for later missions should not be relaxed without scientific review, justification, and consensus.

Attachment B: Letter from NAC Planetary Protection Subcommittee Chair to NAC Science Committee Chair
November 20, 2012

TO: Wesley T. Huntress, Chair, NAC Science Committee

FROM: Eugene H. Levy, Chair, Planetary Protection Subcommittee

RE: Background to the PPS/Science Committee Recommendation through the NASA Advisory Council that NASA institute a Procedural Requirements Document on planetary protection for human exploration missions.

NASA Policy Document 8020.7G on "Biological Contamination Control for Outbound and Inbound Planetary Spacecraft" (hereinafter "NPD") defines NASA's Planetary Protection Policy to "cover all space flight missions" and designates the Associate Administrator for the Science Mission Directorate (SMD), as the official responsible for overall implementation of NASA's planetary protection policy, with the Planetary Protection Officer as the SMD AA's designee.

The NPD tasks the Associate Administrator for the Human Exploration and Operations Mission Directorate (HEOMD, by reference to the AA for Space Operations Mission Directorate and to the AA for Exploration Systems Mission Directorate) to ensure that applicable standards and procedures are established under the policy, in coordination with the Planetary Protection Officer, and that the consequent requirements in "detailed subordinate implementing documents are incorporated into human space flight missions."

The Planetary Protection Subcommittee notes that the US/NASA adheres to international agreements under which COSPAR establishes common standards for planetary protection in the conduct of space missions. COSPAR has established and published planetary protection standards for human space missions. Currently, however, NASA has not established the required "subordinate implementing documents" for human missions. The Planetary Protection Subcommittee has submitted a recommendation that the requisite implementing documents be established, in accordance with NASA policy and COSPAR guidelines.

Establishing a formal requirements document is important to do now, in order to address misconceptions regarding NASA's planetary protection policy. For example, the recent report of the National Research Council (*Space Technology Roadmaps…*, 2012) stated erroneously (on pg. 225):

> Similarly, it was observed that NASA planetary protection policies are limited to robotic missions. Until those policies are updated to provide guidance on human exploration, in compliance with recent COSPAR planetary protection policies, it would be premature to invest in new technologies relevant to planetary safety in TA07. [Emphasis added.]

in fact, COSPAR planetary protection policies have been updated to provide such guidance on human exploration, but the absence of a NASA Requirements Document obscures that fact, with manifest consequences as illustrated here.

Consequences of No Action on This Recommendation

1. Failing to implement the mandated Planetary Requirements Document will continue to promulgate an apparently widespread misperception that planetary protection requirements only apply to robotic mission. In the absence of such a document, ongoing efforts to develop technologies intended for the eventual human exploration of Mars is likely to follow pathways that are not compliant with planetary protection requirements for human missions to Mars, which would represent wasted effort and resources.
2. In the absence of this requirements document, NASA will be out of compliance with its own policy mandate as it plans the prominent flagship missions of human exploration, and out of step with international agreements to which the U.S. is a party. Planetary protection requirements constitute an international commitment of longstanding, having both crucial scientific implications and addressing matters of potential significant and broad-scale public concern. Planetary protection, especially as pertains to Mars exploration and the prospect of back contamination, whether the vector is a rock or a person, is not unlikely to become a matter of significant public concern at such time as human exploration of Mars might become an imminent reality. In the meantime, the development of support systems for human exploration is anticipated to focus on technologies that are generalizable along a path connecting precursor missions to eventual Mars-ready human-support systems. Failure to incorporate planetary protection standards at an early time would likely jeopardize this desirable technology-evolution path, and compromise the effective utilization of development resources. Altogether, lack of clearly defined and implemented standards for planetary back-contamination protection will reduce NASA's ability to retire the certain risks, and weaken the Agency’s ability to respond to important drivers of Mars exploration from both scientific and public interest perspectives.

Background

In 2008, on the basis of advice from the U.S. Space Studies Board and information gathered by several NASA-sponsored and international workshops, guidelines on planetary protection requirements for human missions to Mars were formally approved by the Committee on Space Research (COSPAR) of the International Council for Science. COSPAR advises the UN Committee on the Peaceful Uses of Outer Space on scientific aspects of compliance with Article IX of the 1967 Outer Space Treaty (OST), as an international consensus standard. The United States is a party to the Outer Space Treaty. NASA policy (NPD 8020.7 and NPR 8020.12) requires compliance with COSPAR provisions on planetary protection, referencing OST Article IX.

NASA planetary protection policy applies equally to human and robotic missions, and specifies compliance with COSPAR guidelines on planetary protection; however, NASA currently has no NPR document providing requirements for human missions. The Planetary Protection Subcommittee of the NAC Science Committee has recommended that an NPR document be established now to support planning efforts for human deep space exploration missions, to be updated as planning progresses and as new information and policy revisions dictate.

Specifically, the PPS recommends that NASA adopt the current COSPAR guidelines for Mars into a new NPR document to ensure that the NASA policy of requiring compliance with COSPAR policy is made explicit for near-term human mission planners. (A draft of the NPR document has been prepared by the NASA Planetary Protection Office).

It is recognized that, as knowledge evolves, revisions to the NPR document may be called for. At an appropriate time, the National Research Council's Aeronautics and Space Engineering Board and the Space Studies Board, in cooperation with the European Science Foundation, should prepare a joint report to refine planetary protection requirements for human missions to Mars and other exploration targets. This would build on the prior Aeronautics and Space Engineering Board-Space Studies Board (ASEB-SSB) National Research Council (NRC) *Safe on Mars* report (which was prepared jointly by the Aerospace Engineering Board and the Space Studies Board, 2002) to inform future NASA policy, incorporating subsequent scientific, technological, and other developments.

Recent History

NASA has been developing guidelines on planetary protection requirements for human missions to Mars for over a decade. In 2001, a workshop on *Planetary protection issues in the human exploration of Mars* was held at Pingree Park, Colorado, to consider in detail the concerns for planetary protection that would be raised by the human exploration of Mars. In 2002, the ASEB and the SSB of the U.S. National Research Council published the *Safe on Mars* report (with Rick Hauck as Chair), that contained a number of recommendations regarding steps necessary to ensure the health of astronauts during Mars exploration. A second NASA-sponsored workshop was held in early 2005 at the Lunar and Planetary Institute in Houston, Texas to consider additional issues in *Life support, Habitation, and Planetary Protection* co-sponsored by SMD Planetary Protection and ESMD Advanced Life Support and Extravehicular Activities. The objective of these activities was to assess the potential for ensuring both protection of the Mars environment and preservation of astronaut health and the environment of the Earth after return, by identifying concerns and developing guidelines for planetary protection on human missions to Mars.

Results of these three efforts were considered at an international workshop held at ESA-ESTEC in mid-2005, co-sponsored by NASA and ESA. That workshop developed guidelines for review by the agencies and planetary exploration communities. The refined guidelines were subsequently communicated to COSPAR, and accepted at the biannual assembly in 2008 as part of COSPAR's policy by the Panel on Planetary Protection and the COSPAR Bureau and Council.