COSPAR PLANETARY PROTECTION POLICY ***with Explanatory Annotations***

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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.

Meaning: Spacefaring nations must conduct missions in ways that avoid harmful contamination of Outer Space (including the Moon and other celestial bodies) and adverse changes to Earth. They must comply with COSPAR Planetary Protection Policy, which represents both procedural standards and accepted guidelines consistent with the UN Outer Space Treaty and relevant international agreements.

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.

Meaning: COSPAR Principles and Guidelines are not optional for human missions to Mars (or to other bodies where the possibility of indigenous life may exist).

General principles include:

- Safeguarding the Earth from potential back contamination is the highest planetary protection priority in Mars exploration.

Meaning: Concerns about back contamination of Earth are the priority focus in mission planning and implementation during human missions—but forward contamination avoidance

must also be addressed. Plans, designs and implementation must be on the basis of the best available scientific information at the time of mission formulation, and updated as appropriate.

- The greater capability of human explorers can contribute to the astrobiological exploration of Mars only if human-associated contamination is controlled and understood.

Meaning: Human missions will contribute to our understanding of Mars and other bodies, but only if human-associated contamination is understood and controlled. Implementation approaches can be varied—such as monitoring of microbial populations associated with humans during the mission, and reduction/control of released microbial contaminants from human support hardware and systems. For example, it will be important to have an understanding of process streams of life support systems (air, water, wastes, etc) from a human microbiology perspective, including an end-to-end understanding of venting, dispersal and shutdown considerations to minimize release of contaminants and enable containment/disposal of wastes in suitable ways during all phases of the mission. Forward contamination requirements may limit the discharge of liquids, solids and gases.

- 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.

Meaning: Release of Earth organisms during a Mars surface mission is inevitable, but should be limited at levels based on the best available scientific information. For example, development of sterilization and decontamination capabilities will be needed for generated wastes, spacecraft volumes (habitats, pressurized rovers, lab modules, etc.) and associated equipment and samples. Among the types of pathways and operations that will need special planning are airlock operations, contamination and inhalation during don of spacesuits, venting during EVA, and inseparable transfer into the habitats and later to Earth. EVA and ALS systems will thus need to consider planetary protection requirements that accommodate human functional performance capabilities. In addition, crew protection and backward contamination requirements may influence ISRU operations, particularly those that create resources that are transported into the habitat and can be inhaled or consumed by the crew.

- Crewmembers exploring Mars, or their support systems, will inevitably be exposed to martian materials.

Meaning: Since some exposure of astronauts to Mars materials will undoubtedly occur, it must be understood and controlled based on best available scientific information and technologies to address the associated risks.

In accordance with these principles, **specific implementation guidelines** for human missions to Mars should 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.

Meaning: Development of monitoring technologies will be needed to evaluate the level/type of microbes released by human associated activities on an on-going basis during the mission, with capability for monitoring microbes in real time (in habitats, EVA, suits, labs, etc) , integrating system technologies to protect human life from pathogenic and /or alien microorganisms (should they exist), and shielding engineering systems from bio-corrosion.

- 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.

Meaning: Detailed formulation of quarantine needs and capabilities will need to be determined on a mission-by-mission basis, in consultation with relevant experts and agencies on the basis of the best available scientific advice and understanding of risks. Appropriate technologies for quarantine and containment of crew and samples will be needed for both nominal and off-nominal situations. As part of normal crew health monitoring and in support of the assessment of possible quarantine measures, basic tests of the medical conditions of the crew and their potential responses to pathogens or adventitious microbes will need to be employed regularly on the mission.

- 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.

Meaning: Building on studies and protocols from other round trip and sample return missions (e.g. Apollo, Mars Sample Return, etc.) a protocol for handling, testing and assessing returned humans and samples will need to be developed, incorporating the most up-to-date science, technology and operations during all mission phases. Mitigation capabilities and strategies will also be needed in the event of off-nominal releases of contamination during various mission phases.

- Neither robotic systems nor human activities should contaminate "Special Regions" on Mars, as defined by this COSPAR policy.

Meaning: Special Regions are defined, in COSPAR policy, on the basis of the best available scientific information about both Earth life and putative Mars life. Accordingly, systems will be needed to allow controlled, aseptic, subsurface sampling operations so that uncontaminated samples can be returned to the surface, and so that human-associated contaminants are not introduced to the subsurface.

- 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.

Meaning: Site characterizations on Mars will need to be established based on the best available scientific information, whether data come from precursor robotic missions, robotic excursions, or ground-based assets or equipment. Additionally, special attention will be needed to plan for

servicing or maintaining items and equipment brought into the habitat between distinct excursions or sampling activities during human missions.

- 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.

Meaning: Detailed requirements for sample containment will need to be developed in consultation with experts and on the basis of the best available scientific advice and understanding about risks. Special attention will be needed for the design of technologies and operations associated with collection, containment, transfer and special handling of sample materials both on Mars and during the return trip to Earth.

- An onboard crewmember should be given primary responsibility for the implementation of planetary protection provisions affecting the crew during the mission.

Meaning: An assigned person on the mission will be responsible for making real-time decisions, on the basis of established policy, in scenarios where direct consultation with Earth is not feasible. The mission will need the tools and training to assess and control possible Martian biology if encountered under various scenarios.

- 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.

Meaning: Both forward and backward contamination risks will need to be understood fully based on the best available scientific and technical information at the time of mission formulation, and updated appropriately. For example, it will be important to explore contamination avoidance requirements posed by instruments and activities used in astrobiological/geological exploration of Mars and to examine how EVA and ALS systems may affect them. Additionally, development of responses to off-nominal scenarios and contaminations events will involve planetary protection considerations as well as crew health/safety concerns.