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*Expanding Options for
Implementing Planetary Protection During Human
Space Exploration & Robotic Precursor Missions*

**PLANETARY ROBOTIC EXPLORATION and
HUMAN SPACEFLIGHT
COORDINATING GROUPS**

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Robotic Exploration Coordinating Group
Human Spaceflight Coordinating Group

Study Objectives :

Expanding Options for Implementing Planetary Protection During Human Space Exploration & Robotic Precursor Missions

- **Follow up on two reports to the 2010 IAA Summit**
 - Future Human Spaceflight: the Need for International Cooperation
 - Protecting the Environment of Celestial Bodies (PECB Report)
- **Involve international and national actors,**
 - UN Committee on Space Research [COSPAR Planetary Protection Policy]
 - National and Regional Space Agencies
 - Commercial Space Exploration
- **Identify Future Needs - PP and Human Missions**
 - Technologies and procedures for space exploration *beyond* Earth Orbit
 - Crosscutting applications with other international needs?



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Background

- **COSPAR maintains planetary protection policy** since 1960s
 - Developed from IAF meeting in Rome in 1956
 - Covered in Article IX of the 1967 Outer Space Treaty
 - Objectives are to protect the environment of the Earth and scientific investigations on the origin and evolution of life
- **Guidelines for human missions developed over past decade**
 - Most bodies have no PP concern for contamination by Earth life
 - Need biological monitoring capabilities to assess astronaut health
 - Contamination of Mars to be minimized: how?
- **Engineering and systems design/operation are key**
 - Incorporate future Mars needs into design for near-term missions?
 - What information is needed to improve capabilities? R& TD?
 - Integrate into Mission Designs Early



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Work Underway (2013-15)

- **Interim Progress To Date**

- Recruited Participants from Europe, US, India, Russia
- Initial Telecons: Background information and draft outline of report
- Work Process: Developed “Scope of Needs” to Make Stepwise Progress

- **Already**

- ID Key Systems, Operations & Equipment Likely to be Impacted by Planetary Protection Concerns (Cross Cutting)
- Preliminary Examination of Current Capabilities & Knowledge Gaps
- Draft Science and Technical Findings
- Considering Ways to Foster International Cooperation & Progress



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Systems, Operations & Equipment Impacted by PP

[Begin Assess Current Capabilities and Knowledge Gaps]

• Biological Monitoring – ID microbes <i>in situ</i>	• Quarantine Facilities (Indiv. & Crew)
• Equipt. Decontam /Sterilisation Methods	• Waste Disposal Processes/Containment
• Biodiagnostics, Medical Treatment (crew)	• Updated Human PP Protocol
• Advanced Life Support Systems (ALS)	• Understand Fwd. & Back Contamination Pathways
• Extravehicular Activity (EVA) & EVA Equipment	• Material Inventory (process products & streams)
• Spacesuit Designs (including ALS)	• Leakage & Release Mechanisms from Habitat
• Ingress/Egress (crew, materials, equipt.)	• Biocontainment & Handling in Labs
• Drilling Equipment (subsurface sampling)	• Closed Loop & Recycling Capabilities to Minimize Mass
• Sample Containment, handling, transfer	• ISRU Systems



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Key Policy, Science & Technical Findings to Date

1. COSPAR Planetary protection provisions should be incorporated into mission planning, development & operations for all human and robotic missions beyond low-Earth-orbit.
2. Essential for future Human Missions beyond Earth Orbit: The capability to closely monitor both human-associated microbes and human health consequences of microbial exposure
3. Need robust, complementary robotic hardware capabilities that minimize/mitigate release of biological contamination during exploration, collection, containment and sample handling on Human Missions
4. Environments with biological potential (for either Earth organisms or ET life) must be appropriately defined, and thoroughly characterized & mapped robotically prior to being carefully accessed by human explorers.



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Ways to Foster International Cooperation & Progress

- 1 International coordination of planetary protection planning, research, and technology development is essential for successful implementation on future human missions.
- 2 International partnerships should insist on the incorporation of planetary protection principles in all aspects of future mission planning, including road-mapping and strategic planning, *whether by governmental or private entities*.
- 3 The principles and methods essential to planetary protection for human missions have a high degree of utility on Earth (provide a means to secure and facilitate involvement of new international space nations and partners in work related to space exploration).
- 4 In order to ensure a common understanding of the importance of PP principles associated with future planning and designs, there is need for proactive dissemination of information about planetary protection to international audiences (via reports, courses, journal articles, professional publications, and conference etc.)



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**Robotic Exploration Coordinating Group
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Working participants include:

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- **Additional participants still welcomed:**

- To participate contact:

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Anticipated Final Study Report: ~ 2 Years



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QUESTIONS ?