The National Academies of SCIENCES ENGINEERING MEDICINE

Assessment of the Report of NASA's Planetary Protection Independent Review Board

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Member of: The Committee to Review the Report of the NASA Planetary Protection Independent Review Board - 2020

And

Member of: The Committee to Review Planetary Protection Policy Development Processes - 2018

Mars Exploration Program Analysis Group

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Assessment of the Report of NASA's PPIRB

2018 National Academies SSB Report

Review the history of planetary protection policy development, assess the current policy development process, recommend changes and improvements to deal with future issues and needs.

2019 NASA Planetary Protection Independent Review Board Report

Develop U.S. policies that properly balance the legitimate needs for planetary protection with the scientific, social, and economic benefits of public and private space missions.

2020 National Academies SSB Report

Assess the consistency between the findings and recommendations in the 2018 SSB report (***Review and Assessment of Planetary Protection Policy Development Processes***) and those in the 2019 NASA Planetary Protection Independent Review Board report.

Review and Assessment of Planetary Protection Policy Development Processes

Major conclusions: Overview of NASA processes

<u>Finding</u>: NASA needs to address aspects of the following issues:

- **Managing planetary protection policy implementation,**
- **Securing relevant outside expert advice,**
- **Developing a long-range forecast of future solar system exploration missions having planetary protection implications,**
- **Setting planetary protection research and technology investment priorities, and**
- **Identifying the agency's strategy for dealing with major policy issues such as sample-return and human missions to Mars and private sector solar system exploration missions. *(NB: report cited concept of exploration zones.)***

<u>Recommendation</u>: NASA should develop a planetary protection strategic plan that clearly responds to each of these issues.

PPIRB Background (2 of 2)

PPIRB Membership

Dr. Alan Stern, PPIRB Chair	Southwest Research Institute
Dr. Edward (Beau) Bierhaus	Lockheed Martin
Dr. Wendy Calvin	University of Nevada-Reno
Dr. Amanda Hendrix	Planetary Science Institute
Dr. Christopher H. House	Pennsylvania State University
Dr. Hernan Lorenzi	J. Craig Venter Institute
Mr. Tommy Sanford	Commercial Spaceflight Federation
Dr. Erika Wagner	Blue Origin
Dr. Andrew Westphal	University of California at Berkeley
Mr. Charles Whetsel	Jet Propulsion Laboratory
Mr. Paul Wooster	SpaceX
Dr. T. Jens Feeley, Study Manager	NASA Headquarters (Ex Officio)

Selected Findings & Recs: Moon and Mars Categorization

Major Recommendation: NASA should study how much of the Moon's surface and subsurface could be designated PP Category I versus Category II.

Major Recommendation: NASA should reconsider how much of the Martian surface and subsurface could be Category II vs. IV.

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Committee Membership

- Joseph Alexander*, Alexander Space Policy Consultants, Chair
- David Fidler*, Washington University School of Law & Council on Foreign Relations
- G. Scott Hubbard*, Stanford University
- Rosaly Lopes, Jet Propulsion Laboratory
- Margarita Marinova, Independent consultant
- H. Jay Melosh, NAS, Purdue University
- Kirsten Siebach, Rice University
- Caroline Smith, Natural History Museum, London
- Trista Vick-Majors, Michigan Technological University
- A. Thomas Young, NAE, Lockheed Martin (Retired)
- David H. Smith* (*Study Director*)
- Mia Brown* (*Research Associate*)

* 2018 committee participant

Assessment of the Report of NASA's PPIRB

Report Outline

1. Introduction
   Background and context (including summary descriptions of the 2018 SSB report 2019 PPIRB report, and reorganizations of COSPAR's Panel on Planetary Protection and NASA's Office of Planetary Protection)

2. Assessment of the PPIRB's Findings And Recommendations
   Point-by-point comparison of the 77 PPIRB findings and recommendations with the 2018 SSB report

3. Conclusions and Recommendations
   Synthesis of recurring themes, major conclusions, and priority recommendations:

   1. Areas of consistency;
   2. Areas of inconsistency and concern;
   3. New topics for consideration (topics not addressed in the 2018 report;)
   4. Strategic findings and recommendations; and
   5. Expediting development of new approaches to planetary protection.

Assessment of the Report of NASA's PPIRB

PPIRB Findings/Recommendations Sorted Relative to 2018 Report

Major sections of the PPIRB report	Consistent	Inconsistent	Not Comparable
General and Overarching	23	3	8
Planetary Protection Categorization	1	0	5
Human Space Flight	9	0	2
Private-sector Initiatives/Missions	6	1	1
Robotic Mars Sample Return	5	0	4
Ocean World Exploration	0	0	4
COSPAR	1	3	1
Totals	45	7	25

Assessment of the Report of NASA's PPIRB

Areas where the PPIRB and 2018 Reports are Consistent

1. Importance of U.S. leadership in planetary protection
2. Equal applicability of policies to both government and non-government missions
3. Lack of agreement about implementation for private sector space missions and need to identify a federal agency to regulate nongovernmental entities
4. Importance of international cooperation and COSPAR's historical role
5. Impact of new dimensions, including private sector initiatives, humans to Mars, and MSR
6. Need to respond to the changes in the context of space activities:
    * Reorganization of NASA's Office of Planetary Protection,
    * Incorporation of new science & technology,
    * Definition of human exploration zones on Mars, and
    * Planetary protection policy for the human exploration of Mars, and
    * Issues arising from private-sector space activities.
7. Need for timely definition of planetary protection requirements
8. Need for input from all stakeholders
9. Clear public communication.

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Areas where the PPIRB and 2018 Reports are Inconsistent or Raise Concerns

1. Respective roles of COSPAR and the U.N. Committee on the Peaceful Uses of Outer Space in the development of planetary protection policies.

2. Legal relevance of the obligations in the Outer Space Treaty for private-sector missions.

3. Idea of needing to balance planetary protection and various mission objectives as if they were competing aims.

4. The term "planetary protection" is confusing.

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PPIRB Topics not Discussed in the 2018 Report

1. Re-categorization of missions to the Moon, Mars, and small solar system bodies
2. Cost challenges for small, low-cost, spacecraft (e.g., SmallSat and CubeSat) missions
3. NASA's potential role in providing planetary protection assistance to new, private-sector space activities
4. Opportunities for future NASA contracts as a means of enforcing planetary protection policies
5. Sanctions for private-sector actors that do not follow planetary protection policies
6. Martian meteorites' relevance to back contamination policies
7. Impact of bioload-reduction sterilization techniques on science
8. Whether Mars is already contaminated by previous robotic missions and whether the impacts of future robotic and human missions are "likely to be minimal"

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Areas of Strategic Importance Common to Both Reports

1. Establishing a new advisory process

2. Clarifying legal and regulatory issues

3. Building the scientific and technical foundations of planetary protection policies for human missions to Mars

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Establishing a New Advisory Process for Planetary Protection

Recommendation: NASA should establish a new, permanent, and independent advisory body formally authorized to provide NASA with information and formulate advice from representatives of the full range of stakeholders relevant to, or affected by, planetary protection policy.

Recommendation: The initial focus of the new advisory body should be on the needs of upcoming private sector and government missions.

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Clarifying Legal and Regulatory Issues

Recommendation: NASA should work with other agencies of the U.S. government, especially the U.S. Department of State, to provide the private sector with a clear and authoritative explanation of the U.S. government's obligations under the Outer Space Treaty to authorize and continually supervise the space activities of non-governmental entities that raise planetary protection issues.

Recommendation: NASA should work with other agencies of the U.S. government, especially the FAA, to produce a legal and regulatory guide for private-sector actors planning space activities that implicate planetary protection but that do not involve NASA participation. The guide should clearly identify:

1. Where legal authority for making decisions about planetary protection issues resides;
2. How the United States translates its obligations under the Outer Space Treaty into planetary protection requirements for non-governmental missions;
3. What legal rules apply to private-sector actors planning missions with planetary protection issues; and
4. What authoritative sources of information are available to private-sector actors that want more guidance on legal and regulatory questions.

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Building the Scientific and Technical Foundations of Planetary Protection Policies for Human Missions to Mars

Recommendation: NASA should make the development and execution of a strategy to guide the adoption of planetary protection policy for human missions to Mars a priority, including:

1. A process to identify the most promising concepts for achieving planetary protection objective in the context of human missions, such as high-priority astrobiological zones and human exploration zones;

2. Establishment of an adequately funded program of research and development to answer questions and address challenges raised by the most promising concepts…for integrating planetary protection measures in human missions; and

3. A plan to develop planetary protection policy for human missions to Mars on a timeline that permits the integration of such research and development into mission planning and implementation at the earliest possible stages.

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Expediting the Development of New Approaches to Planetary Protection

Recommendation: NASA should undertake the following actions

1. Develop a broad-based, representative advisory process to inform the development of planetary protection policy for small, low-cost, spacecraft;

2. Identify, fund, and complete research and development priorities related to small, low-cost, spacecraft missions (e.g., on analyzing base costs for planetary protection compliance and on crafting a standard planetary protection template);

3. Clarify the legal and regulatory environment for small, low-cost, spacecraft used in missions that are not subject to agreements or contracts with NASA; and

4. Record, analyze, and communicate the lessons learned from specific small, low-cost, spacecraft efforts in order to inform the development and implementation of the new approach to planetary protection policy as recommended by the PPIRB and 2018 reports.

Mars Issues

PPIRB Major Recommendation: NASA should reconsider how much of the Martian surface and subsurface could be Category II versus IV by revisiting assumptions and performing new analysis of transport, survival and amplification in order to reassess the risk of survival and propagation of terrestrial biota on Mars (37)

NASEM 2020 Response: Categorization of Mars missions as either III, IV, or restricted sample return V (see Appendix E) is grounded in scientific data collected over the past 50 years, but particularly in the last 20 years of the "follow the water" Mars Exploration Program.

Now, however, Mars is an attractive object for not only scientific exploration but also commercial space ventures and human exploration. The 2018 report noted that commercial interests want to minimize uncertainty and expense and that human exploration faces particular planetary protection challenges.

That report did not recommend moving some missions (e.g., Mars landers) to Category II, but it did recommend that "NASA's process for developing a human Mars exploration policy should include examination of alternative planetary protection scenarios and should have access to the necessary research that informs these alternatives."

Thank You

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