National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of: Science Mission Directorate 23 August 2005

Mr. Richard A. Cook
Manager, Mars Science Laboratory Flight Project
M/S T1723-118
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, California 91109-8099

Subject: Mars Science Laboratory (MSL) Planetary Protection Categorization

Dear Mr. Cook:

I have received Pete Theisinger's letter of 2 February 2005 requesting Planetary Protection Categorization for the MSL Project's mission in accordance with NPR 8020.12B. I am also in receipt of the Project's Planetary Protection Categorization Justification White Paper, version 1.0, dated 28 January 2005.

Both documents have proposed an implementation of the mission to meet the requirements of COSPAR's Category IVc—requirements that are now incorporated by NASA in the "C" version of NPR 8020.12, issued 27 April 2005—and have provided options for mission implementation that include either restrictions on landing sites, reduction of spacecraft bioburden, or both. I very much appreciate the efforts taken by the Project to understand and characterize the planetary protection implications of taking MSL to Mars, and particularly wish to state that Project's White Paper was deemed by the peer reviewers, the Planetary Protection Advisory Committee (PPAC; see enclosure), and my office to be a thorough, impressive, and commendable analysis of the issues.

Nonetheless, the White Paper's capable analysis also demonstrated that the central issue in understanding the potential for a Radioisotope Power Supply (RPS) containing spacecraft to contaminate its landing site is one of the probability of growth (P_g) of Earth organisms in the martian subsurface. Unfortunately, neither the peer reviewers nor the PPAC agreed that the Project could make a convincing case that that P_g argument could be, within our current understanding of the parameters, persuasive in allowing the Project unrestricted access to all desirable landing sites on Mars. In the words of PPAC, "this conclusion should not be construed as a criticism of the MSL project team's analysis, but rather as an observation on the state of the art." Given the historically high incidence of Mars-lander failures, the presence of an RPS, and the increased sensitivity regarding special regions derived from the interpretation of multiple data sets from Mars, additional constraints will be necessary to achieve the goals of NASA's planetary protection policy as defined in NPD 8020.7F.

As requested, the MSL mission is hereby assigned as Category IVc in accordance with NPR 8020.12C, with the following options for implementation (assuming an RPS is incorporated into the final design for the landed portion of the mission):

1. Prepare the landing system to meet Viking post-sterilization cleanliness requirements (controlled cleaning and assembly as noted below, followed by a system-level dry heat microbial reduction step in accordance with NPR 8020.12C), with control of recontamination through launch and delivery to Mars:
   - Under this option no restrictions on landing sites or on horizontal or vertical mobility into martian special regions would be imposed on the MSL mission by my office.

Or

2a. Prepare the landing system to meet Viking pre-sterilization cleanliness requirements in accordance with NPR 8020.12C, including the following top-level requirements:
   - The total bioburden for exposed exterior and interior spacecraft surfaces of the "landed system" shall not exceed 3×10^5 spores at launch, with the average bioburden not exceeding 300 spores per square meter, as measured by the NASA standard microbial assay.

2b. In addition, the portions of the sampling apparatus or any other portions of the spacecraft that will contact the martian subsurface must be subject to a sterilizing treatment providing no less than a four-order-of-magnitude reduction in the spore population measured by the NASA standard microbial assay. The required reduction is based on an initial bioburden of no more than 300 spores per square meter:
   - Dry heat is the approved decontamination method, and specifications for its use are provided in NPR 8020.12C. Alternative methods require a demonstration of effectiveness by the Project and approval by my office;
   - The Project must provide the facility or equipment and the means to accomplish this decontamination. The facility or equipment will be subject to certification and the means of decontamination and/or bioburden reduction will be subject to approval and monitoring;
   - Following the final pre-sterilization microbiological assay and microbial sterilization procedure, the Project must demonstrate that the sterilized elements are adequately protected against recontamination. This may require the use of biobarriers. Whatever the means of protection, the Project must provide demonstrated evidence that contamination requirements are not compromised following sterilization treatment.

2c. The mission will be limited to landing sites not known to have extant water or water-ice within 1 m of the surface. One-sigma landing ellipses that address failure modes subsequent to parachute opening at Mars need to fall outside such areas. In addition, later access to martian special regions (as defined by NPR 8020.12C) will be permitted only by vertical mobility, through the use of sterilized sampling hardware, as detailed above. No horizontal access through mobility by an unsterilized rover will be allowed:
   - Proposed landing sites will be reviewed by my office for compliance with this requirement pre-launch, and prior to the preparation and presentation of landing site options to the Science Mission Directorate Associate Administrator.

For either option, other requirements, including documentation, are as specified in NPR 8020.12C:
   - All flight hardware shall be assembled in Class 100K (or better) clean room facilities, with appropriate controls and procedures.
   - The probability of impact of Mars by the launch vehicles shall not exceed 10^{-4}.
   - The project shall provide an organic material inventory of bulk constituents (> 1 kg) for all launched hardware. In addition, the project should archive a 50 g sample of any organic material of which more than 25 kg is used.

- The Project will provide for periodic formal and informal reviews by my office, which I anticipate will include formal reviews to coincide with the ATLO spacecraft readiness review, the pre-ship review, and pre-launch readiness review; and informal reviews, as necessary.
- Independent verification bioassays. The Project shall accommodate, on a non-interference basis, independent assays by my office to confirm the spacecraft bioburden before launch. These assays will be conducted while the spacecraft are at the Kennedy Space Center (KSC) spacecraft preparation facilities, and/or prior to the application of the terminal sterilization process to the lander's sampling apparatus or any other portions of the spacecraft that will be similarly processed to contact the martian subsurface.

The Project shall also provide for Program-sourced bioassays, as applicable, to account for spacecraft microbial diversity. These will be conducted on a non-interference basis, and will focus on both the spacecraft and its surroundings during spacecraft assembly and processing both at JPL and while at KSC/CCAFS. To the maximum possible extent it is expected that these assays will be integrated with those required to achieve Category IVc requirements.

Please let me know if you have any questions on this Categorization or its implementation requirements. Meanwhile, I wish you the best of success in meeting the Project's various challenges, and look forward to working with you.

Sincerely,

John D. Rummel
Planetary Protection Officer
NASA Headquarters

Enclosure

cc: SSE/Dr. Meyer
Mr. Dahl
Mr. McCuistion
JPL/Dr. Li
Dr. Buxbaum
Ms. Newlin
Windermere/Mr. Stabekis