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EXHIBIT III

PLANETARY PROTECTION REQUIREMENTS

This material is based on formal categorizations and draft requirements provided by the NASA Planetary Protection Officer for the 2003/05 MSR Project (which has been cancelled). The requirements in this exhibit should be taken as goals in developing the MSR concepts in this study. Benefits of deviation from these requirements should be quantified.

Categorizations

The following categorizations are assigned consistent with the provisions detailed in NPD 8020.7E and NPG 8020.12B.

Lander/Rover -- Category IV B
Orbiter -- Category III
Mars Ascent Vehicle/ Earth Return Vehicle /Earth Entry Vehicles -- Category V (restricted Earth return).

Draft Implementation Requirements

Forward Contamination/Outbound Phase --

- Category III Orbiter (impact avoidance and contamination control)
  - The probability of impact of Mars by the launch vehicle, including upper stages, shall not exceed 10^{-4}.
  - Assembly and maintenance in Class 100,000 (or better) clean room facilities
  - The probability of impact on the surface of Mars shall not exceed $1x10^{-2}$ for the first twenty years from the date of the launch, and $5x10^{-2}$ for the period of twenty to fifty years from the date of the launch (alternatively, the orbiter may reduce the total bioburden--surface, mated, and encapsulated--to $5x10^{5}$ spores).
  - The Project shall demonstrate that the Earth Entry Vehicles (EEV's) are not surface contaminated by dust during Mars aerocapture, or provide protection against such contamination.

- Category IV Landers (including landed rover[s])
  - The total probability of accidental impact on the target planet by any hardware other than the probe or lander modules (systems not meeting bioburden requirements) must not exceed 10^{-4}.
  - Organic materials inventory for material in quantities = 1 kg. Samples of not less than 50 gm of each organic material present in quantities = 25 kg.
  - Category IV A: Bioburden on exposed surfaces shall be an average of = 300 bacterial spores per square meter, and the total vehicle surface burden shall be = $3.0x10^{5}$ bacterial spores (as assayed by the standard method).

- Category IV B: Bioburden on exposed surfaces shall be equivalent to the Viking post-sterilization surface bioload (by inference, a total of 30 spores--that is, 3.0×10^5 reduced by no more than 4 decades--per the specification for hardy organisms.) Dry heat is the approved decontamination method, and alternative methods require a demonstration of effectiveness by the Project and the approval of the Planetary Protection Officer. Following the terminal microbiological assay and any microbial reduction procedure (as required), the Project must demonstrate that the lander is adequately protected against recontamination.

The Category IV B requirement is driven by the Program-level science requirements (life detection) and by the need to provide for an effective hazard-determination protocol prior to the release from containment of the returned samples (see below). Assuming that no other life-detection instruments are carried on the Lander, a relaxation from the level of bioburden reduction specified for Category IV B may be approved. Any relaxation will require a demonstration, by modeling and appropriate experimentation, that the probability of a single viable Earth organism contaminating the sample returned to Earth within each sample container is $<10^{-2}$. Implementations that can effectively "mark" round-trip Earth organisms may result in a modification of this requirement.

Back Contamination/Inbound Phase --

- The sample container (SC) shall be sealed to an integrity which for planning purposes should be such that the probability of releasing a = 0.2 μm particle into the Earth's biosphere is less than10^{-6}. The SC/EEV system should be able to maintain the required seal integrity under all nominal environmental conditions and under non-nominal operational conditions.

- The SC/EEV system shall be capable of being additionally contained in the event of non-nominal entry conditions, and shall be capable of being transported to an appropriate containment facility within the continental United States. The integrity of the SC seal shall be capable of being maintained until it is opened within a Biosafety Level 4 (BL-4) containment facility. The system shall be capable of being opened using standard laboratory equipment, or with equipment provided by the Project that can be surface-sterilized and cleaned of organic and inorganic materials that could contaminate the sample with Earth material.

- The EEV shall be kept free of unsterilized Mars contamination. Only the sealed SC or hardware that has been sterilized shall be transferred to the EEV. The SC exterior shall be either fully isolated from the martian environment throughout its lifetime, surface sterilized, or otherwise shown to be free of martian contamination. The transfer operation from Mars to the EEV shall be accomplished without contaminating the Earth Return Vehicle (ERV).

- There should be the capability to verify the successful execution of events (such as containment, sealing, and aseptic transfer) and the condition of the sample container at key points in the mission. In particular, the successful completion of the events that provide for the attainment of the required sample containment seal should be known prior to the deployment of the EEV(s) into Earth's atmosphere.

- The probability of inadvertent impact of Earth by the ERV/EEV system prior to EEV release shall be $<10^{-6}$. Subsequent to EEV release, entry of the ERV into the Earth's atmosphere shall be avoided until it can be demonstrated that SC sealing was fully effective in preventing ERV contamination by unsterilized Martian materials. Absent that demonstration, ERV entry into Earth's atmosphere shall be avoided.

- After custody of the returned samples is passed to those responsible for sample containment and analysis, the Project shall support the implementation for the hazard-determination protocol and the initial sample characterization by providing Project-obtained data about the samples, including any *in situ* characterization data and detailed information about the sites and the geological context in which each of the samples was collected on Mars.

Certifications

The Project shall plan to provide data to the Planetary Protection Officer to support multiple certifications of the attainment of planetary protection objectives for the missions. These will be required before systems are launched from Earth, before launch of the Mars Ascent Vehicle from Mars, and before samples are committed to Earth entry. These certifications will require timely information in order to allow for the timely attainment of mission objectives.

The Project may propose alternative implementation strategies in its Planetary Protection Plan, provided they are shown to be equivalent to the baseline requirements.