



Planetary Protection for Phobos-Grunt

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Project Perspective



“ In conclusion, it is important to note that delivery of soil to Earth from the moon of Mars and the return of Earth microorganisms which have spent a long time in the conditions of outer space will be accomplished for the first time in the history of cosmic exploration. It places enormous responsibility on us and means careful fulfillment of all the requirements of planetary protection in two important directions: protection of Mars from Earth's microorganism (necessary for future study of the planet) and protection of Earth from possible extraterrestrial contamination.”

Categorization of Phobos-Grunt



- In 2002, Roskosmos asked the Russian Academy of Sciences Institute for Medical-Biological Problems (IMBP) to review and support the Phobos-Grunt mission
 - The mission has been assigned Category V, Unrestricted Earth Return, following the ‘Six Questions’ for small bodies as described in COSPAR policy
 - Outbound requirements are as for Category III Mars orbiters, using orbital lifetime as the implementation approach
 - Beyond the Cat. V designation, the Phobos-Grunt project plans to provide for tight sealing of the return capsule and strict containment of the returned samples, in compliance with a 1999 Russian law “On the Sanitary-Epidemiological Well-Being of the Population,” with advice from the IMBP

Cat. III Orbital Lifetime Approach



- Requirements involve demonstrating probabilities of 99% to avoid impact for 20 years, and a 95% to avoid impact for 50 years
 - The Phobos-Grunt project performed an extensive assessment of reliability for critical hardware components and a maneuver-by-maneuver analysis of failure probabilities over time, resulting in a probability of successfully avoiding impact over 50 years of 99.79%
 - The YH-1 subsatellite will be released into a highly elliptical orbit with nominal pericenter of 800km: the probability of this subsatellite being released into an orbit that would impact Mars in under 50 years was assessed at 0.03%
 - The Phobos-Grunt analysis takes a different form than that used by NASA or ESA, and translated documents are only recently available(10 May): cross-referencing is ongoing

Transfer of Mars Ejecta to Phobos



- NASA Planetary Protection is funding work to assess the probability for transfer of ejecta from Mars to Phobos or Deimos over time
 - The temporal and spatial distribution of Mars material that could be transferred to the moons, including explicitly the age and location of impact craters on Mars with particular attention to timescales on the order of 10,000, 100,000, and 1,000,000 years
 - The size range of particles produced by impact that could reach the moons' orbits, including both orbital and sub-orbital (ballistic) ejecta
 - The amount and size range of martian material possibly accreted to each moon, over time and by distribution across the surfaces
 - any post-accretion mixing or modification (e.g., gardening) of the transferred material, that could affect the probability of inclusion in a collected sample intended to be returned to Earth
- Include a summary of the assumptions, models, and approaches used, descriptions of the observational evidence considered, and identify confidence limits and uncertainties