1 Planetary protection status of NASA space missions

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Several United States National Aeronautics and Space Administration space missions of planetary protection (PP) consequence (category 3 and higher outbound requirements) are currently operating in space. In order of launch dates they are Mars Global Surveyor (MGS), Mars Odyssey, Mars Exploration Rover (MER), and Mars Reconnaissance Orbiter (MRO).

MGS originally was launched on November 7, 1996 and entered Mars orbit on September 12, 1997. It is in its 2nd PP extended mission. Its current orbit has sufficient lifetime so that its probability of impact of Mars is within the requirements (0.01 for the period 20 years after launch and 0.05 for the succeeding 30 years). The original plan to raise the orbit (and to end the science mission) was modified based on a later re-analysis of the orbital lifetime, which involved a refined model of the Mars atmosphere at the orbital altitudes of interest. The model was published,[1] and the new analysis was reported and approved in the MGS PP Extended Mission Report. Although a PP significant redundancy has been lost due to a failure of a reaction wheel, the orbital lifetime precludes a PP violation even in the event of a system failure such as loss of attitude control. Otherwise, the orbiter is in good health and operating satisfactorily.

Mars Odyssey originally was launched on April 7, 2001 and entered Mars orbit on October 23, 2001. It is in its 2nd PP extended mission. Its current orbit does not have sufficient lifetime so that its probability of impact of Mars is within the requirements (0.01 for the period 20 years after launch and 0.05 for the succeeding 30 years). The re-analysis of its orbital lifetime with the new atmospheric model and an advanced analysis method[2] did significantly reduce the magnitude of the required and planned periapsis raise. Based on the good health of the orbiter and the re-analysis, the raise can be delayed until 2010. This postponement will permit further extended missions to obtain more science data. These results have been reported in an approved Mars Odyssey PP Extended Mission Report.

The MER launches were June 10, 2003 and July 7, 2003. Spirit arrived on Mars on January 3, 2004, and Opportunity arrived on January 24, 2004. The PP compliance, including the bioburden requirements, was reported in 2004 COSPAR. Since the landings were nominal, PP status is no longer an issue.

MRO was successfully launched on Aug. 12, 2005. The pre-launch PP status was reported at COSPAR 2004, and will be presented in a separate expanded paper at COSPAR 2006. The mission is nominal as a healthy spacecraft approaches Mars.

All of these missions and also the category 2 mission Cassini are in full PP compliance. The category 2 mission Deep Impact and the category 5 “Unrestricted Earth return” (UER) mission Stardust recently have been successfully completed. The category 5 (UER) mission Genesis suffered a recovery mishap, but the event was not a PP violation.

[1] Mark A. Vincent, Explanation and history of the new solar cycle/ atmospheric model used in Mars planetary protection analysis, JPL D-21422, August 2001and the AAS/AIAA Astrodynamics Specialists Conference, Quebec City, Quebec, Canada, July 30-Aug. 2, 2001.

[2] The “trinomial method:” Mark A. Vincent, “A New Method of Determining Orbit Lifetime Probabilities for Use In Planetary Protection Analysis,” AAS/AIAA Astrodynamics Conference, Sun Valley Idaho August 1997.