

Planetary protection implementation on Mars Reconnaissance Orbiter mission

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In August 2005 NASA launched a large orbiting science observatory, the Mars Reconnaissance Orbiter (MRO), for what is scheduled to be a 5.4-year mission. High resolution imaging of the surface is a principle goal of the mission. One consequence of this goal however is the need for a low science orbit. Unfortunately this orbit fails the required 20-year orbit life requirements set in NASA Policy Guideline. So rather than sacrifice the science goals of the mission by raising the science orbit, the MRO Project chose to be the first orbiter to pursue the bio-burden reduction approach for an orbiter.

Because the orbiter is so large, cleaning only is insufficient to achieve the bio-burden threshold requirement in NASA Policy. This presentation outlines one of the processes developed to reduce bio-burden by taking credit for hardware that will either never reach the surface or will reach high temperature (500C for 0.5 seconds or more) during entry due to ablation and aero-heating. Lockheed Martin engineers developed a process to perform what is called breakup and burn-up (B&B) analysis.© This process considers the assumptions that go into modeling and into decision methods that result on structural degradation branching points. Several components aboard the orbiter were predicted to fail the minimum time at temperature requirements (or could not conservatively be shown to meet the conditions). An implementation plan was generated to address the highest contributors to the bio-burden assessment that fail to meet the requirements. The spore burden for these components was estimated by direct and proxy burden assays, NASA PP specifications, and dry heat microbial reduction, as appropriate. Items on the orbiter that required rework during assembly were also individually assessed. Assembly, Test and Launch Operations are an integral part of the implementation plan. MRO was given Planetary Protection approval for flight based on meeting the required spore burden assessment at launch based on the implementation of the B&B analysis and of the MRO Planetary Protection Implementation Plan and the verification of the measured bio-burden by the NASA Planetary Protection Officer's independent assays.

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