

Panels (P)

Planetary Protection Mission Implementation and Status (PPP.2)

EMM: PLANETARY PROTECTION IMPLEMENTATION PLAN

Mohsen Al Awadhi, mohsen.alawadhi@mbrsc.ae

Mohammed Bin Rashid Space Centre, Dubai, United Arab Emirates

Emirates Mars Mission: Planetary Protection Implementation Plan

The United Arab Emirates is planning to launch a spacecraft to Mars in 2020 as part of the Emirates Mars Mission (EMM). The EMM spacecraft, Amal, will arrive in early 2021 and enter orbit about Mars. Through a sequence of subsequent maneuvers, the spacecraft will enter a large science orbit and remain there throughout the primary mission. This paper describes the planetary protection implementation plan for the EMM mission.

The EMM science orbit, where Amal will conduct the majority of its operations, is very large compared to other Mars orbiters. The nominal orbit has a periapse altitude of 20,000 km, an apoapse altitude of 43,000 km, and an inclination of 25 degrees. From this vantage point, Amal will conduct a series of atmospheric investigations.

Since Amal's orbit is very large, the plan is to demonstrate a very low probability that the spacecraft will ever encounter Mars' surface or lower atmosphere during the mission. The EMM team has prepared methods to demonstrate as follows:

A. the launch vehicle targets support a 0.01% probability of impacting Mars, or less, within 50 years B. the spacecraft has a 1% probability or less of impacting Mars during 20 years; and C. the spacecraft has a 5% probability or less of impacting Mars during 50 years.

The EMM approach to planetary protection is to bias the trajectory away from Mars so that the resulting probability of impact with Mars meets the probability requirements. The approach assumes failure of the Space Segment and avoids the need for a probability of failure analysis. The project views this as a conservative approach and more defensible than leveraging a reliability analysis. The significance of this approach is that the launch vehicle must place the upper stage and observatory on trajectories that satisfy planetary protection, and the project recognizes the cost of additional fuel to maintain the trajectory bias. This approach is satisfied by trajectory and navigation. The description of the Space Segment is included for information only.

The purpose of the Planetary Protection Implementation Plan (PPIP) is to provide all relevant information about the detailed implementation (e.g. analysis, procedures, and activities) of the planetary protection requirements in line with the planetary protection plan.

The EMM mission design resembles the mission design of many previous Mars missions, differing only in the specific parameters and final destination. The mission involves a direct launch toward Mars, a 7-month Type I cruise to Mars, a standard Mars Orbit Insertion (MOI), a transition from the capture orbit to the science orbit, and a scientific investigation in a high orbit about Mars. Special care is given to each phase to ensure that planetary protection guidelines are followed.