LESSONS LEARNED FOR THE MARS 2020 MISSION FORWARD PLANETARY PROTECTION IMPLEMENTATION.

Moogega Cooper¹, Brian Shirey², Gayane Kazarians³, and Kristina Stott¹ ¹California Institute of Technology, Jet Propulsion Laboratory, 4800 Oak Grove, Pasadena, CA 91109 USA, moogega.cooper@jpl.nasa.gov, timothy.b.shirey@jpl.nasa.gov, gayane.a.kazarians@jpl.nasa.gov, kristina.v.stott@jpl.nasa.gov

Introduction: Planetary protection (PP) Implementation for a flagship mission is an extremely complex process, often involving coordination with internal teams, vendors, and external agencies. Developing and executing an effective PP implementation plan involves strategizing spacecraft bioassay sampling timing, bioburden accounting, and effective coordination with the build engineers. Throughout this process, several lessons learned were gathered and documented in the Mars 2020 post-launch report. The objective of this documentation was to help future missions understand potential and realized pitfalls to improve future processes.

Lessons Learned: The lessons learned were divided into several categories: Early Mission planning, Sampling coordination and implementation, Aseptic Assembly Facility, Facility, Launch Vehicle, and Genetic Inventory. Strictly focused on the Sampling coordination and implementation subset, the following lessons highlight a few of the documented lessons:

PP/Contamination Control (CC) Dry Heat Microbial Reduction Requirements Matrix - For the Mars 2020 mission, a PP/CC requirements matrix tool was developed and implemented in order to clearly relay PP requirements in an traceable and clearly defined package to project staff, CogE’s and other pertinent individuals. The requirements matrix proved to be an invaluable tool and resource which could be accessed throughout the course of the mission when PP requirements and process instructions needed to be identified for flight hardware. However, this matrix was only developed for the primary and secondary flight subsystems, and not for instruments and payloads. Recommendation: In addition to the primary system/subsystem PP requirements matrix, develop individual PP requirement matrices for each instrument in order to facilitate the transmission of PP requirements and processes to each instrument team.

Count Alert Level Communication - As knowledge and tools have evolved for each mission, so has the level of communication to the team who is conducting the daily spacecraft microbial assay assessment of petri dishes for colony counts. It is imperative that these team members be equipped with the knowledge to alert the PP Lead as soon as the bioburden exceeds the limits so that an appropriate mitigation path can be developed. For past missions, a “stoplight” chart was provided, but it did not consider the bioburden limits or surface areas of the part in question. A newly developed tool for Mars 2020 PP was created to calculate the “Count Alert Level” or CAL for each sampling event so that all team members would be empowered to raise a flag on high bioburden results. Recommendation: Implement the CAL philosophy for future missions so that it is clear when the bioburden has been exceeded. This has allowed for rapid communication with CogEs and vendors to mitigate any issues.

Shift Logs - It becomes difficult to manage the operations of a large PP team on a flagship mission. The solution implemented during this project is to create and send out a daily “Shift Log”. This idea was inspired from CogEs operating the Mars Science Laboratory operating the Qualification Model Dirty Testing (QMDT) testbed; this has worked well on giving a daily summary of activities and current bioburden estimates for each assay. Recommendation: Implement the Shift Log process on future missions so that all leads and management can be kept apprised of the sampling quantities, frequencies, and results in a timely manner.

Acknowledgments: The research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA (80NM0018D0004).

References:
