



# **MSL Lessons Learned & Knowledge Capture**

**Karen L. Buxbaum**

**Mars Program Planetary Protection Manager**

**Jet Propulsion Laboratory, California Institute of Technology**

**Planetary Protection Subcommittee Meeting at NASA HQ**

**May 1, 2012**



# The PPS Recommendation

*Mars Program Planetary Protection*

**The PPS recommended preparation of an extensive “lessons-learned” report, to be completed while the MSL Planetary Protection team remains intact and available for preparation of the report.**

**The recommendation was that “the report should include:**

- 1. Issues with spacecraft materials and contamination control that may affect measurements made either in situ or after return**
- 2. Key elements of a bioburden accounting software package that can be developed jointly for use in the Mars Sample Return (MSR) campaign**
- 3. Publication of the Adenosine Triphosphate (ATP) assay as related to the NASA Standard Assay, to facilitate adoption of this assay for bioburden accounting on MSR elements**
- 4. Research needed to improve the assessment of proposed landing sites in the context of concerns for liberation of fluids from hydrated or frozen ground in the presence of a Radioisotope Power System.”**

***Excerpt from the recommendation: “The now potentially long hiatus in U.S. Mars surface operations for sample return threatens an especially severe loss of accumulated knowledge and experience.”***



# MSL Lessons Learned and Knowledge Capture

*Mars Program Planetary Protection*

- The Planetary Protection Subcommittee recently requested a presentation from the Mars Program addressing MSL lessons learned and knowledge capture activities.
  - Some knowledge capture activities are already in motion
- This briefing is timely in light of the NAC's recent acceptance of the PPS recommendation that a formal lessons learned activity be undertaken.
- The recommendation is also well-timed in that members of the MSL planetary protection team at JPL are still available to support lessons learned efforts.
- The Mars Program shares the PPS/NAC concerns about potential loss of information and expertise in planetary protection practice.
- The Mars Program has not had an opportunity to consider any decisions specific to the PPS recommendation *per se*.



# Status of Relevant Knowledge Capture Activities

## *Mars Program Planetary Protection*

- 1. Issues with spacecraft materials and contamination control that may affect measurements made either in situ or after return**
  - This topic would need to draw on expertise of MSL flight team members who are currently focused on landing day August 5 and the commencement of surface operations.
  - Work on MSL materials and contamination related knowledge capture would have to be planned after landing.
- 2. Key elements of a bioburden accounting software package that can be developed jointly for use in the Mars Sample Return (MSR) campaign**
  - Initial work on this topic began already; more on following pages.
- 3. Publication of the Adenosine Triphosphate (ATP) assay as related to the NASA Standard Assay, to facilitate adoption of this assay for bioburden accounting on MSR elements**
  - Initial work on this topic began already; more on following pages.
- 4. Research needed to improve the assessment of proposed landing sites in the context of concerns for liberation of fluids from hydrated or frozen ground in the potential presence of a Radioisotope Power System**
  - This topic also would need to draw on expertise of MSL flight team members who are currently focused on landing day August 5 and the commencement of surface operations.
  - Work on landing site assessment approaches or consideration of research to improve assessments would have to be planned after landing.



# Bioburden Accounting Software

*Mars Program Planetary Protection*

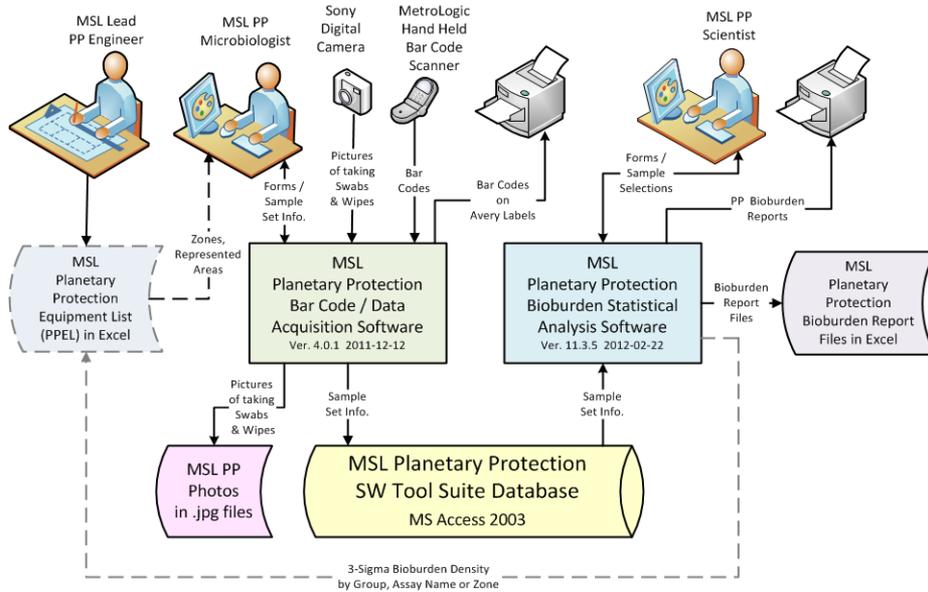
## **Recommended topic #2: Key elements of a bioburden accounting software package that can be developed jointly for use in the Mars Sample Return (MSR) campaign**

- JPL planetary protection teams have, since Pathfinder, developed and progressively enhanced user-developed software programs to facilitate their bioburden accounting and reporting
- The tools are effective, but are not fully documented, not fully integrated, and not currently suitable for either storage for the future or delivery to others for use.
- To better understand the status of the bioburden accounting software, the Mars Program Office recently conducted an appraisal of the software using the expertise of a JPL Software System Engineer and the MSL team member who has been the most recent tool developer and user.
- The appraisal is a valuable start, informing whatever steps are to be taken next.
- The PPO has expressed an intent to take on, from her office, development of a bioburden accounting tool for future mission use.



# MSL Planetary Protection Software Suite Assessment: An Independent Evaluation from a Systems Perspective

## Mars Program Planetary Protection



### Objectives:

To independently characterize and evaluate the JPL MSL Planetary Protection Software Suite from a systems perspective including high level functionality, program complexity and size; assessment of requirements, design, implementation (software, database, user interface), verification and validation, and documentation that includes analysis of approach and identification of strengths and weaknesses

### Deliverables:

- Planetary Protection Software Suite Evaluation Approach
- Planetary Protection Software Suite Evaluation Report that includes assessment and recommendations for:
  - MSL Planetary Protection Bar Code/Data Acquisition Software
  - MSL Planetary Protection Bioburden Statistical Analysis Software
  - MSL Planetary Protection Equipment List (PPEL)

### JPL Lead:

Name: P. A. "Trisha" Jansma  
 Phone: 818-354-0647  
 Email: Patti.A.Jansma@jpl.nasa.gov

### Participating Organizations:

- Software Systems Engineering Group – 313A
  - (M. Smith)
- JPL Biotechnology and Planetary Protection Group – 352N
  - (R. Beaudet, A. Spry)
- JPL Mars Program Office (K. Buxbaum)

### Funding Profile (\$K):

	FY12
MPO	\$15K

### Timeline:

March – April, 2012



# ATP Assay Data

*Mars Program Planetary Protection*

## **Recommended topic #3: Publication of the Adenosine Triphosphate (ATP) assay as related to the NASA Standard Assay, to facilitate adoption of this assay for bioburden accounting on MSR elements**

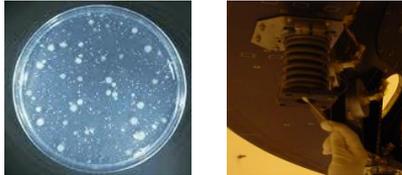
- In the 2001 to 2005 time period, the Mars Program supported development of two molecular assays to expand options and modernize methods for bioburden assessment of spacecraft surfaces—Total Adenosine Triphosphate (T-ATP) and Limulus Amebocyte Lysate (LAL) Assays. Both are rapid but neither counts cultivable spores *per se*.
- MSL made extensive use of the T-ATP (a.k.a. ATP) assay to rapidly assess cleanliness of surfaces during ATLO, thus mitigating the risk of rework after the 3-day spore assay.
- The ATP assay data are not currently consolidated nor organized for further analysis.
- To secure the MSL ATP data, the Mars Program Office has initiated a task to consolidate and secure the data, which can later be analyzed and published, possibly leading the way to making the ATP assay an acceptable substitute for the NASA standard spore assay.



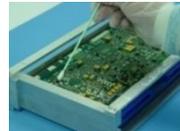
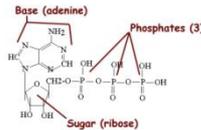
# MSL ATP Data Consolidation

## Mars Program Planetary Protection

### NASA Standard



### ATP Assay



### Objectives:

To consolidate the MSL ATP cleanliness data and associated NASA standard assay data in a documented and coherent format to secure the knowledge base and provide the foundation for a downstream comparative analysis.

### Deliverables:

- A single excel workbook and picture folder containing the consolidation of ATP data from laboratory notebooks, excel worksheets and sampling picture files.
- A single excel workbook and picture folder containing the extraction of the correlating NASA standard assay spore data from the MSL PP Barcode System.
- Excel workbook defining the spacecraft groupings for both the ATP and standard assay samples.

### JPL Lead:

Name: J. Nick Benardini, Ph.D.  
 Phone: 818-354-4453  
 Email: James.N.Benardini@jpl.nasa.gov

### Participating Organizations:

- JPL Biotechnology and Planetary Protection Group
  - (G. Kazarians)
- JPL Mars Program Office (K. Buxbaum)

### Funding Profile (\$K):

	FY12
MPO	19.6

### Timeline:

April – September, 2012



## Other Information & Expertise in PP Practice

*Mars Program Planetary Protection*

- The Mars Program Office's PP budget for the current year includes sufficient funding to start knowledge capture activity that would be of high value to future missions.
  - Vitally important while the knowledgeable people are still able to contribute
  - Prevent the loss of the methods to perform flight project planetary protection
  - Prevent the loss of data and other results of the last 1½ decades of PP-related R&D
  - Any near-term work must be non-interference with currently busy MSL team members (most PP personnel have completed their MSL work at this point; post-launch support is a smaller effort for PP)



# Summary

## *Mars Program Planetary Protection*

- The Mars Program has recently been informed of the PPS recommendation, which was endorsed by the NAC, concerning MSL lessons learned and knowledge capture.
- The Mars Program has not had an opportunity to consider any decisions specific to the PPS recommendation.
- Some of the activities recommended by the PPS would involve members of the MSL flight team who are focused on cruise, entry descent & landing, and early surface operations; those activities would have to wait.
- Members of the MSL planetary protection team at JPL are still available to support MSL lessons learned and knowledge capture; some of the specifically recommended activities have already begun.
- The Mars Program shares the PPS/NAC concerns about loss of potential information & expertise in planetary protection practice.