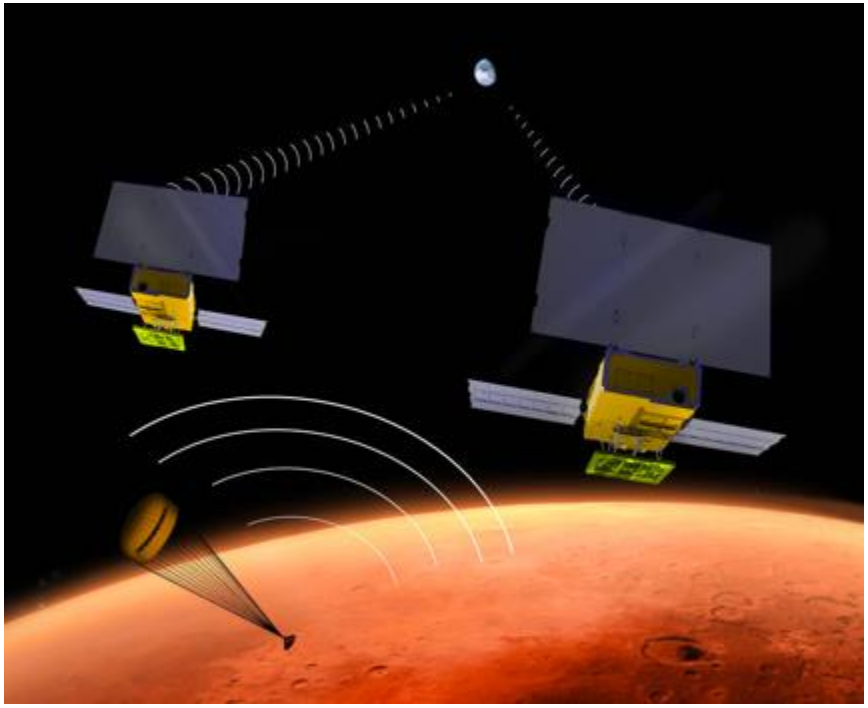

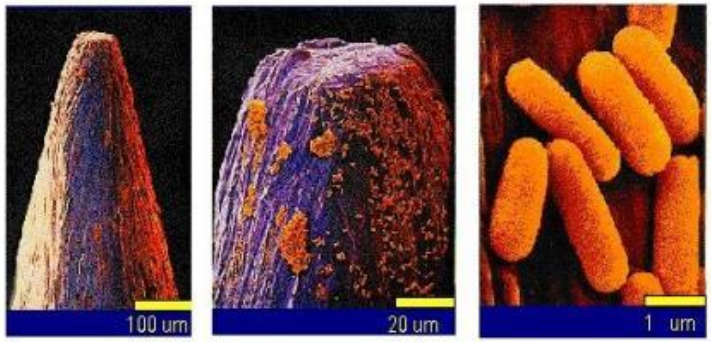

Planetary Protection and SIMPLEx

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Contents

- **What planetary protection isn't.**
- **What it it is.**
- **Proposal Requirements for SIMPLEx**
  - *Categorization*
  - *Documentation*
  - *Hardware Handling and Processing*

What Planetary Protection *isn't*:

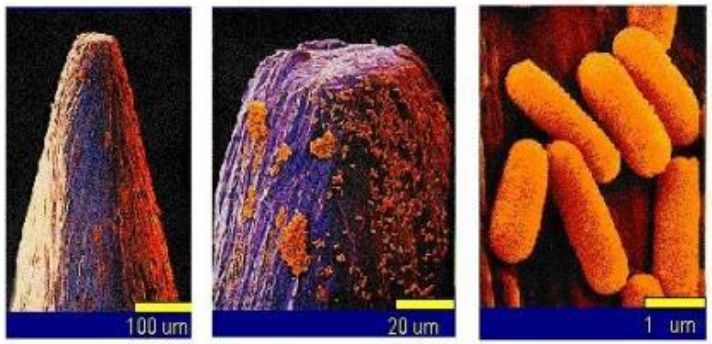
It's not about keeping an eye on the big things..

(asteroids impacting Earth!)

It's not about carrying around mind-erasing ray guns to help you forget about your alien experiences…

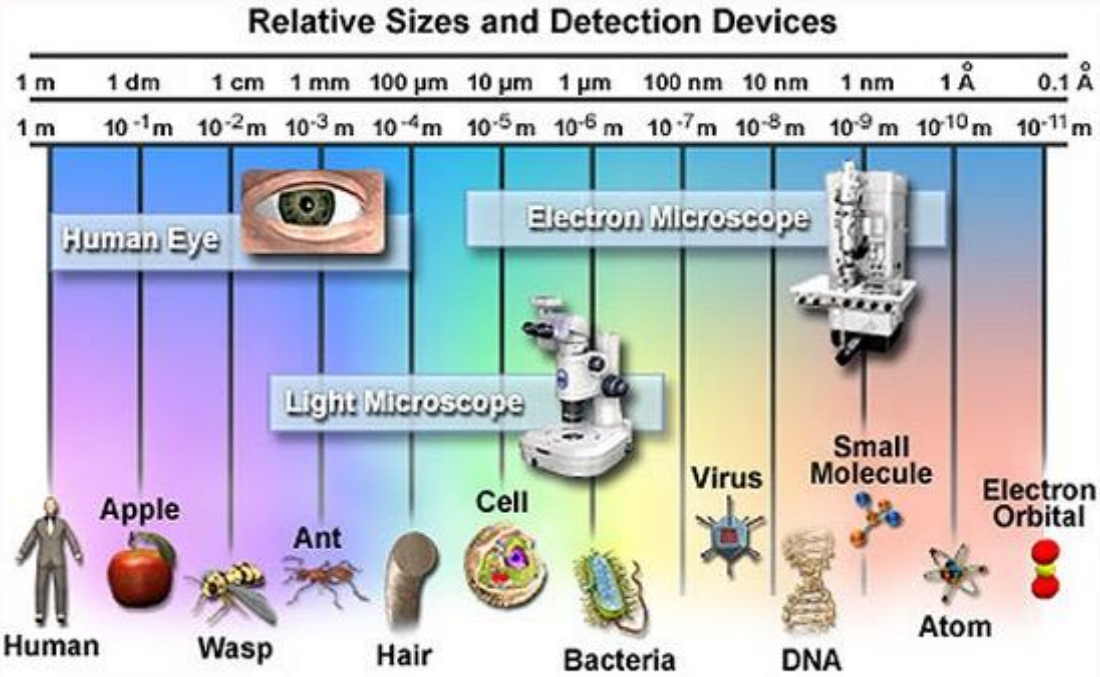
What Planetary Protection is…(1/2)

It's about keeping an eye on the little things…



Orange = bacteria on the head of a pin—there are lots there!

…smaller than what we can see with the naked eye.



What Planetary Protection is…(2/2)

NASA's Office of Planetary Protection is responsible for biological loads (bioburden) carried from Earth to other places in the solar system and to Earth from other places in our solar system.

Protect bodies in the Solar System from our microbes: Keeping opportunities open for future exploration science when we visit…

Protect the Earth from unknown life from other planets: Not closing the door on our Earthly civilization and environment when we bring samples back from elsewhere that may contain life …

Planetary Cubesats and Planetary Protection

NASA-funded or –launched Cubesats shall comply with NASA planetary protection requirements

Section 4.6.3 in the SIMPLEx proposal AO

Requirement J-11. Proposals that include an encounter with a Solar System body other than the Earth (via flyby, orbiter, lander, or impact, including end of mission) shall address plans for contamination control, as required by NPD 8020.7G and NPR 8020.12D, and include all costs associated with planetary protection requirements in the proposed budget.

Requirements

Planetary Protection Requirements Depend Upon:

- *Where you're going*
- *How you're going to get there*
- *What you plan on doing once you get there*
- *If you're going back to Earth*

NPR 8020.12D

Planetary Protection Provisions for Robotic Extraterrestrial Missions

Your Requirements Document

(note: under revision, so the NPR points to an interim document or "NID")

NASA-HDBK-6022

NASA Technical Handbook for the Microbial Examination of Hardware

Guidance document with details for missions that require bioburden measurement and tracking.

https://soma.larc.nasa.gov/SIMPLEx/programlibrary.html

What does the AO ask of you? (1/2)

The Bare Minimum: Preliminary Categorization + Draft Requirements

At a minimum, the proposal should address:

(i) ***Categorization:*** the anticipated planetary protection Category of the mission under NASA directives

(ii) ***"Do No Harm":*** the steps intended to be taken for planetary protection compliance, including potential for affecting primary payload compliance

(iii) ***Operations and Roles:*** the proposed mission operational accommodations to comply with anticipated requirements, including organizational responsibilities

(iv) ***Framework/Plan:*** the proposed steps to be taken for the preparation of flyby, orbital, and/or landed portions of the spacecraft to comply with any requirements for overall microbiological cleanliness and recontamination prevention prior to launch

(v) ***End of Mission Plan:*** ***C***onsistent with Section 4.6.6

(vi) ***Roles/Responsibilities:*** organization(s) responsible for implementing planetary protection requirements.

What does the AO ask of you? (2/2)

"Do no harm" to the primary payload, protect the target body

Proposals should describe, as appropriate to the proposed target body and primary payload, such factors as how the design and material choices are compatible with:

1) bioburden reduction methods for surface and encapsulated bioburden

2) recontamination prevention approaches

and, if relevant

3) reduction of contamination by organic compounds.

Examples of Missions & Ranges of Requirements

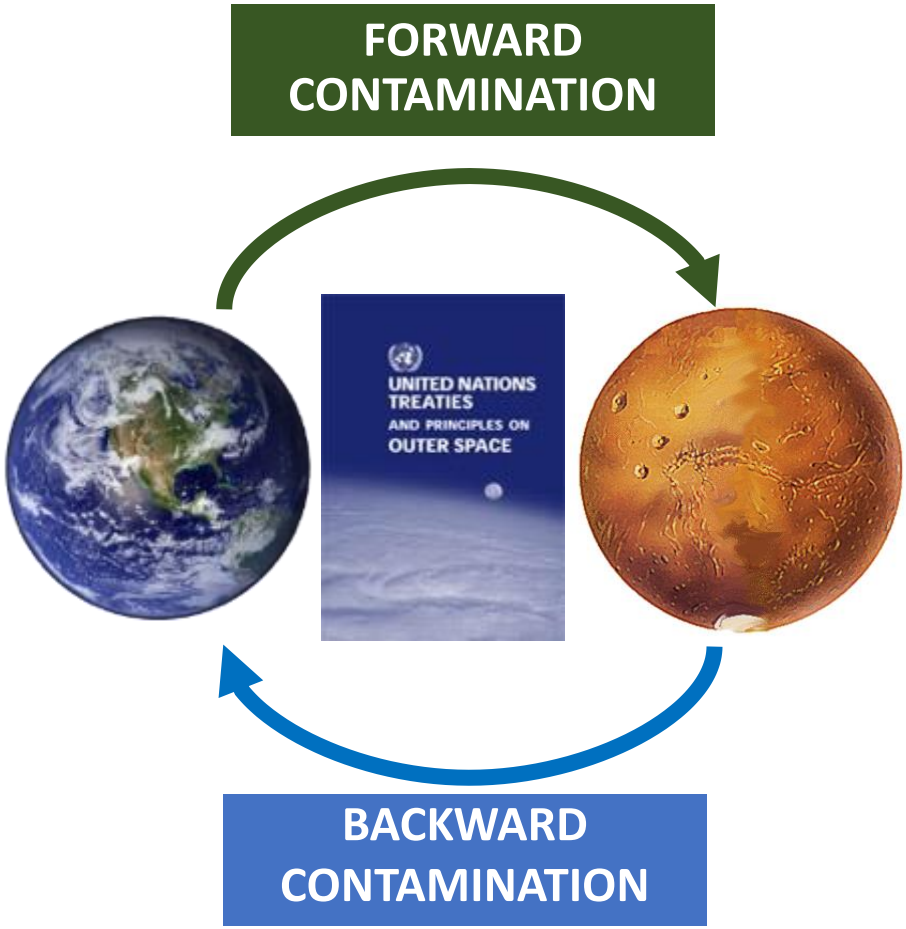
Documentation Only

cubesats

Documentation + Trajectory Analyses

Documentation + Trajectory Analyses + Bioburden Monitoring

Communicating in a common language

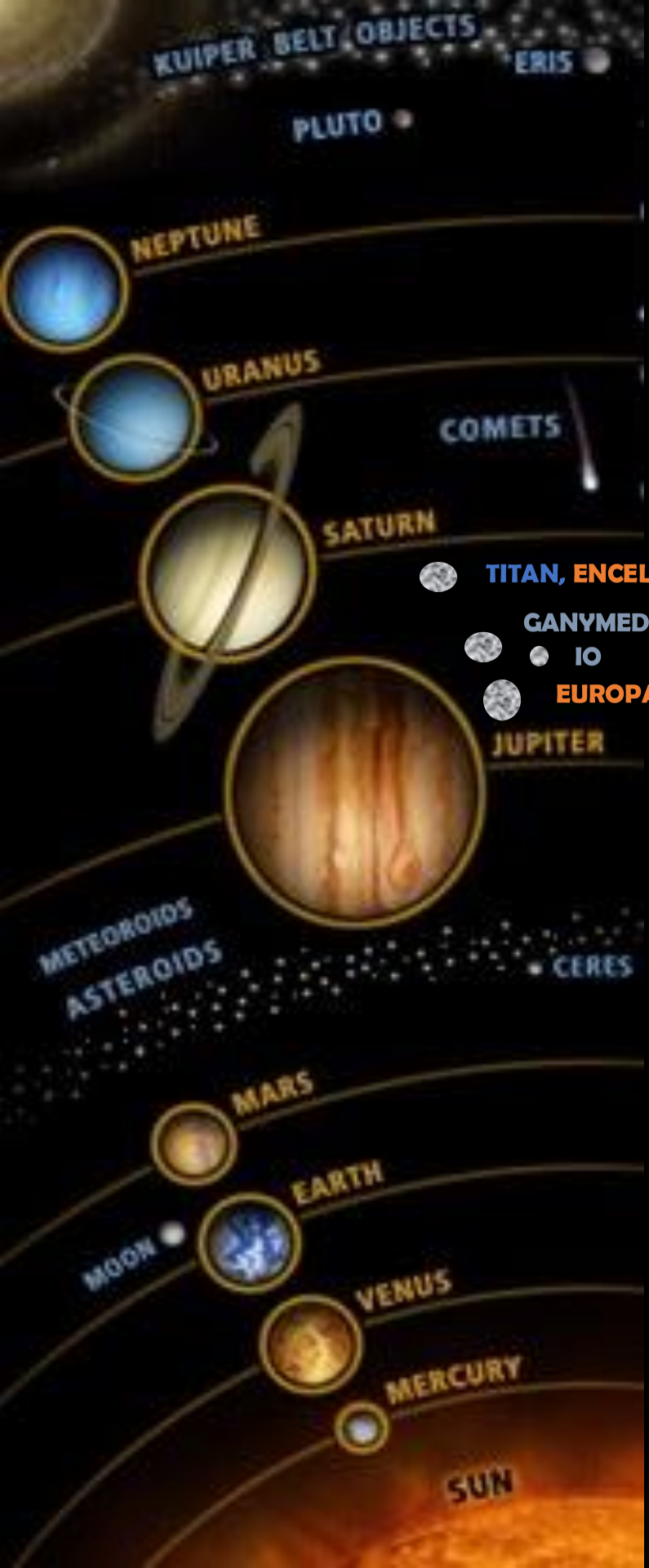


NASA follows the COSPAR guidelines, which provides a common language.

The COSPAR guidelines are reflected NPR 8020.12/NID

Categorization

Categorization	Mission Platform	Planetary Target Priority
I	Any	Not of direct interest for understanding the process of chemical evolution or where exploration will not be jeopardized by terrestrial contamination. No protection of such planets is warranted, and no requirements are imposed. ***Typical Examples: Undifferentiated, metamorphosed asteroids***
II	Any	Of significant interest relative to the process of chemical evolution but only a remote chance that contamination by spacecraft could compromise future investigations. ***Typical Examples: Venus, Moon, Jupiter, Saturn, Uranus, Neptune, Comets, Ceres, Carbonaceous Chondrite Asteroids, Ganymede, Titan, Triton, Pluto/Charon,***
III	Flyby, Orbiter	Of significant interest relative to the process of chemical evolution and/or the origin of life and for which scientific opinion provides a significant chance that contamination by spacecraft could compromise future investigations. ***Typical Examples: Mars, Europa, Enceladus***
IV	Lander, Probe	
V **Restricted Earth Return** **Unrestricted Earth Return**	All Earth Return	All Solar System Missions ***Typical Examples: Restricted = Mars, Europa; Unrestricted: Earth, Venus***



Cat II

Cat II

Cat II

Cat II

Cat II

Cat II, III , IV

Cat II

Cat IV or Cat III

Cat I or II

Cat III & IV

Cat II (moon)

Cat II

Cat I

Green = Missions to these locations have bioburden tracked

Categorization/Requirements: *At a Glance*

Cat	PP Plan	Inventory of bulk organic constituents	Trajectory Biasing	Cleanroom Requirement	Burnup and Breakup Analyses	Subsidiary Plans	Bioassays	Bioburden Reduction	System Sterilization
I									
II									
III									
IV									
V									

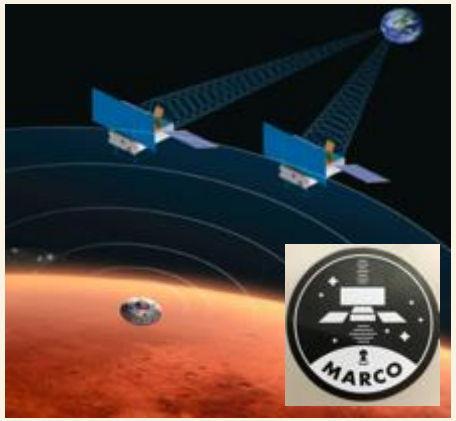
None

Some

All/Significant

Document	Description
Categorization Request	Request by the Project to the PPO to determine the appropriate planetary protection category for their mission to the intended target.
PP Plan	Details the planned approach to compliance with planetary protection requirements (e.g., mission description, probability estimates, microbial burden estimates; includes subsidiary plans [Planetary Protection Contamination Analysis Plan, Planetary Protection Microbiological Assay Plan, Planetary Protection Microbial Reduction Plan])
Planetary Protection Contamination Analysis Plan (can be appended to the PP Plan)	The primary planning document covering the major analyses that are performed by the project and ultimately used to demonstrate to the PPO that the project is meeting the planetary protection cleanliness requirements.
Planetary Protection Microbiological Assay Plan (can be appended to the PP Plan)	Identifies the space vehicle hardware, facilities, and associated environments which are subject to microbiological assay; present the rationale, concepts and detailed procedures pertaining to such assays; and describe the microbiological quality assurance procedures used to ensure validity of the assay results.
Planetary Protection Microbial Reduction Plan (can be appended to the PP Plan)	Submitted for planetary missions involving hardware elements that have their microbial burden reduced to a specified or measures (assayed) level.
PP Implementation Plan	Details the project's implementation of the Planetary Protection Plan. Describes, in detail for each hardware element, the processes, procedures, analyses, and facilities that are used to implement the Planetary Protection Plan and subsidiary plans. This is a project document, and would be expected to have content appropriate to the specific project.
Pre-Launch PP Report	Provides verification to the PPO that planetary protection requirements have been met and that the project will continue to satisfy planetary protection requirements throughout the mission. Includes values of the microbial burden at launch. The inventory of bulk constituent organics, when required, is included in this report.

May 2018: Launch of the first planetary cubesats – MarCO (Mars Cubesat One)



Format: **Two Cubesats (6U)**
Target Body: **Mars Flyby**
Secondaries to: **InSight Mars Lander**
Purpose: **EDL Communication**
PP Category: **III**
End of Mission: **Heliocentric orbit**

- Included "Do No Harm" to the primary payload as driving requirement
- Successful collaboration between Office of Planetary Protection, Launch Services Program, InSight Project (JPL) and MarCO Team (JPL)

If you have additional questions…

"Proposers are encouraged to communicate informally with the Office of Planetary Protection regarding planetary protection categorization and specific requirements with a future mission interest as they relate to design and development. "

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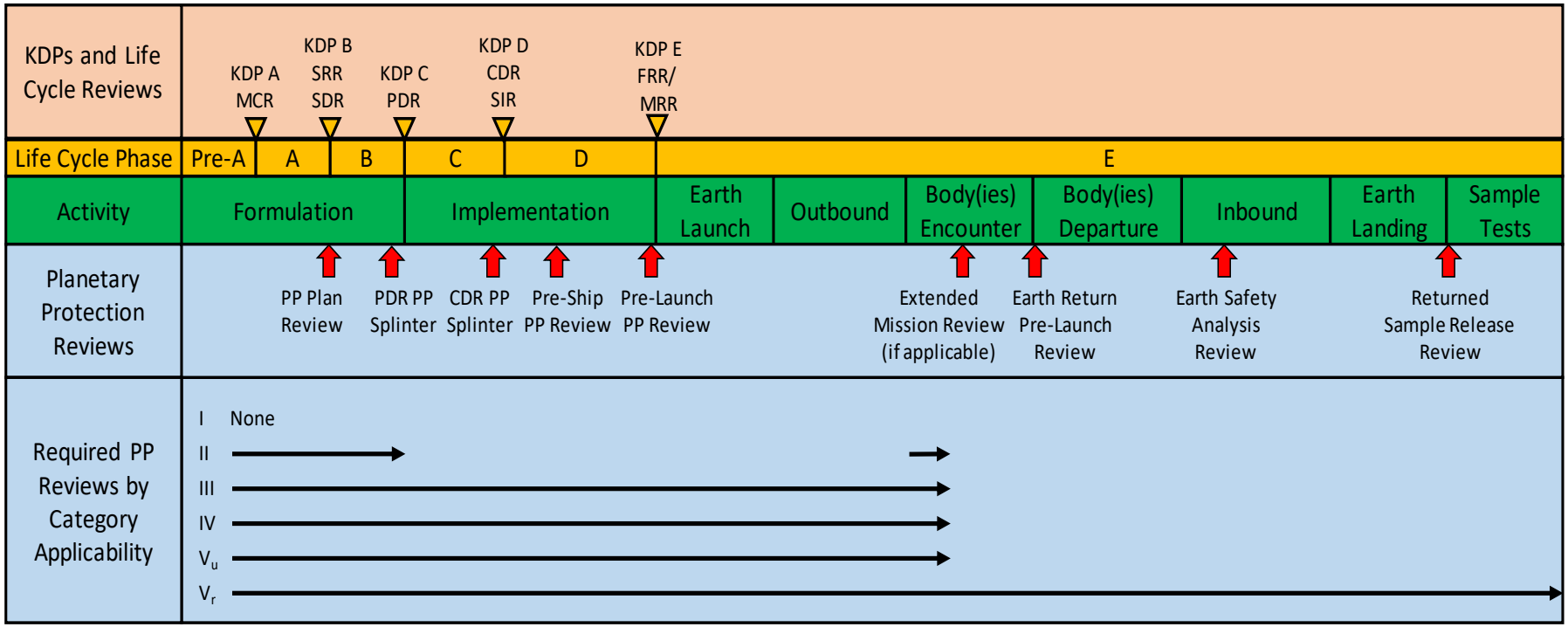
…Useful Project Lifecycle Information…

Review Requirements By Category and Lifecycle



Where,
V_u = Category V Unrestricted Earth Return
V_r = Category V Restricted Earth Return

Documentation Requirements By Category and Lifecycle

	Applicability R = Required; NR = Not Required						Document Maturity									
							Pre-Phase A KDP A	Phase A KDP B		Phase B KDP C	Phase C KDP D		Phase D KDP E	Phase E KDP F		
	I	II	III	IV	V(u)	V(r)	MCR / PP Planning Review	SRR	SDR	PDR	CDR	SIR / Pre-Ship PP Review	MRR/FRR / Pre-launch PP Review	Earth Pre-Return Review	Earth Safety Analysis Review	Returned Sample Release Review	EOM
Mission PP Categorization Request **[PP-17]**	R	R	R	R	R	R	Preliminary	Final									
PP Plan **[PP-18]**	NR	R[1]	R[7]	R	R	R			Draft	Baselined 60 days Prior							
PP Implementation Plan **[PP-19]**	NR	NR	R	R	NR	R				Draft	Baselined 60 days prior						
PP Contamination Analysis Plan **[PP-20]**	NR	NR	R	R	NR	R				Draft	Baselined 60 days prior						
PP Microbiological Assay Plan **[PP-21]**	NR	NR	R[8]	R	NR	R				Draft	Baselined 60 days prior						
PP Microbial Reduction Plan **[PP-22]**	NR	NR	R[8]	R[6]	NR	R				Draft	Baselined 60 days prior						
Pre-Launch PP Report **[PP-23]**	NR	R[2]	R	R	R	R							L-90 days				
Post-Launch PP Report **[PP-24]**	NR	R[3]	R	R	R	R							L+60 days				
PP Extended Mission Report (Plan)[9] **[PP-25]**	NR	R	R	R	R	R											EOM-60 days
Earth Safety Analysis Plan **[PP-26]**	NR	NR	NR	NR	NR	R			Draft	Baselined prior							
End of Mission Report **[PP-27]**	NR	R[4]	R	R	R	R[5]											EOM
Inventory of Bulk Constituent Organics **[PP-28]**	NR	R[10]	R	R	R[10]	R							Final prior				
Return Implementation Plan **[PP-29]**	NR	NR	NR	NR	NR	R					Baselined prior						
Return Pre-Launch Report **[PP-30]**	NR	NR	NR	NR	NR	R							Final prior				
Earth Pre-Return Report **[PP-31]**	NR	NR	NR	NR	NR	R								Final prior			
Earth Pre-Entry Report **[PP-32]**	NR	NR	NR	NR	NR	R									Final prior		
Sample Pre-Release Report **[PP-33]**	NR	NR	NR	NR	NR	R										Final prior	

Notes:

1. Brief plan outlining the intended or potential impact targets. Management and facility information not required
2. Brief report detailing impact avoidance strategies
3. Brief report detailing actual trajectory and any updates to previous documentation
4. Provide the final actual disposition of launched hardware and impact location
5. Includes detailing the transfer of the samples to an appropriate containment facility.
6. Required if any microbial reduction procedures are contemplated.
7. If the mission involves an orbiter, the minim planned periapsis altitude and planned final disposition of the hardware is to be noted
8. For orbiters meeting the bioburden requirement
9. For missions that are intended to be operated beyond the mission duration approved in the Planetary Protection Plan
10. For missions to the earth's moon