Planetary Protection Compliance of NASA Missions – Past, Present and Future

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Relevant NASA PP Presentation at COSPAR 2026 PPP

- Policy and Mission updates
  - Planetary Protection Resources and Guidelines Available for Mission Implementation, Elaine Seasly, PPP,1 -4
  - Adaptation and Evolution of NASA's Planetary Protection Policy to Enable the Moon to Mars Campaign, Nick Benardini PPP.1 -5
  - Planetary Protection Compliance Of Nasa Missions Past, Present And Future, Erin Lalime PPP.1-8
  - ESCAPADE Planetary Protection Approach and Status, Moo Cooper, PPP.1-10
  - A Panel conversation on partnering between CIR and PPP, PPP.1-14
- Planetary Protection Research and Development
  - Implementation of Molecular Methods for NASA Planetary Protection, Ceth Parker PPP.2 -1
  - Standardizing Advanced Biotechnology Techniques for Planetary Protection, Lisa Guan (Moo Cooper) PPP.2-3
  - Introducing NASA's Space Microbial Culture Collection, Jessica Lee (Erin Lalime) PPP.2 -5
  - Novel approaches to Backward Planetary Protection that would enable rapid return of Mars samples and reduced mission complexi ty, Brian Clement PPP.2-8
  - Quantifying Molecular Organic Contamination Signature Transport on the Moon
  - The Contaminant Footprint of Landed Spacecraft: Toward an Inventory and Modeling Framework, William Hoey
- The Future of Planetary Protection for Mars
  - The Mars Planetary Protection Primer: A Practical Decision Framework for Lower-Cost Orbiter and Flyby Missions, Ryan Wooley (Moo Cooper)PPP.3-5
  - Current Status Of Nasa Planetary Protection Risk Assessment For Crewed Mars Surface Missions, Andy Spry PPP.3 -7
  - Mars Science Scope Prior to the Arrival of Humans (MSSPAH): Implications for Planetary Protection, Tim Haltigin PPP.3-8
- Other sessions
  - Lunar orbit evolution and strategies for planetary protection, Anthony Genova B3.2-17
  - Preliminary Findings of the Mars Science Scope Prior to the Arrival of Humans (MSSPAH) Working Group, Poster STF -049

Overview

Past: Planetary protection disposition report for NASA missions that ended in the period since the July 2024 (Athens) COSPAR Scientific Assembly.

Present: Report on planetary protection for ongoing NASA missions

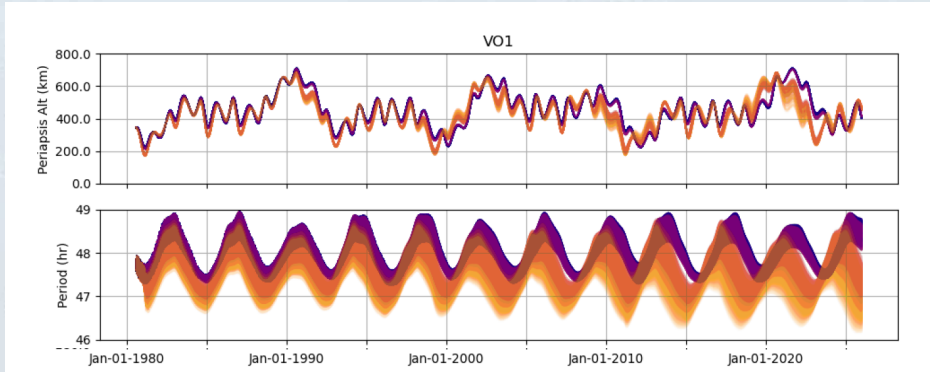
Future: Description of NASA mission in development/study phase and current planetary protection approaches

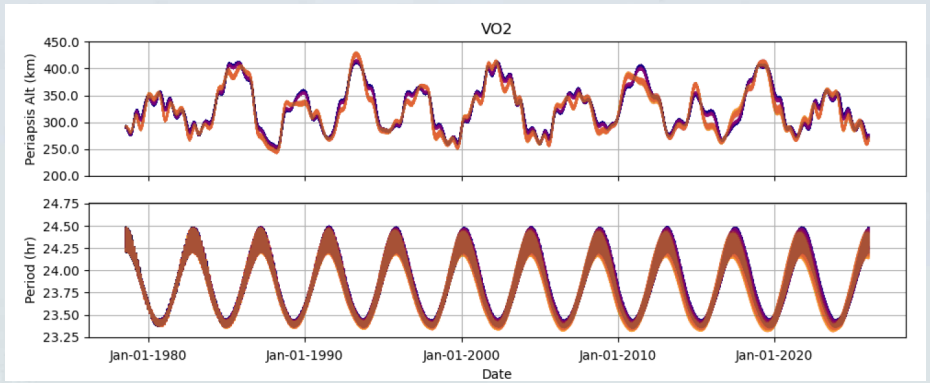
Highlights: **Viking Orbiters, MAVEN, Europa Clipper, Ignition (Moon and Mars),**

50 years since Viking


Viking 1 Lander. July 1976

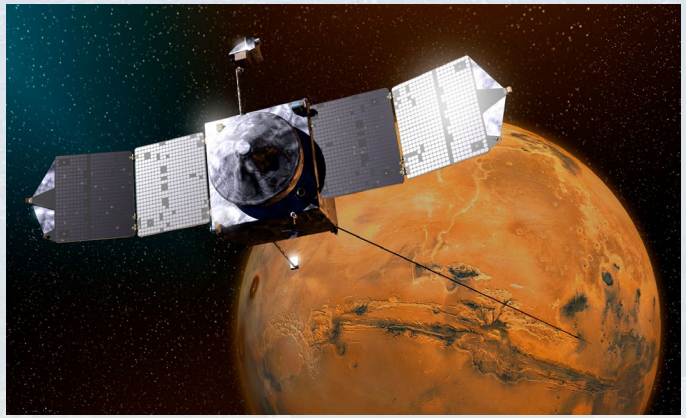
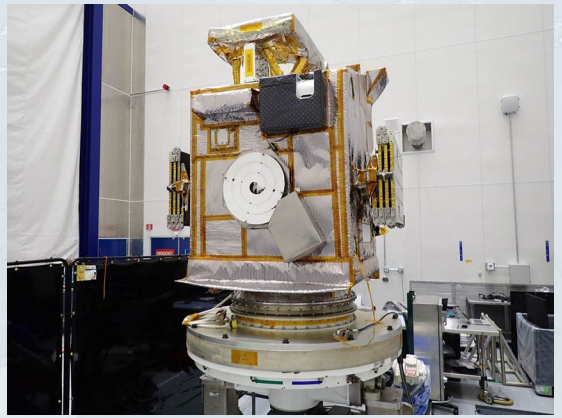
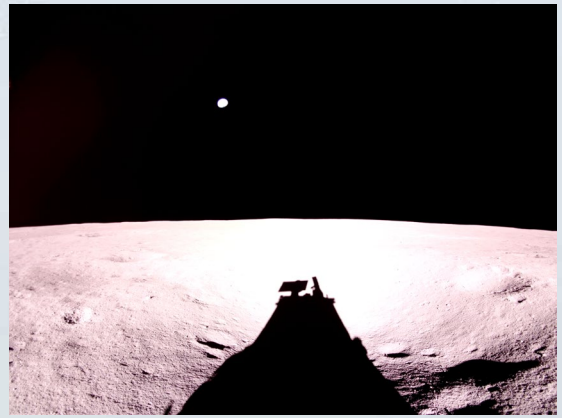
- Viking landers (July 20th and September 3rd 2026) set the gold standard for bioburden on landed hardware for decades
  - *Used a Probabilistic framework to arrive at an acceptable bioburden level*
- Viking orbiters arrived in Mars orbit June 19, 1976 & August 7, 1976
  - *End of mission August 7, 1980 and July 24, 1978*
  - *Before decommissioning both were set into higher or stable orbits*
  - *2009 and 2026 JPL analysis of Viking orbiters indicate that the orbiters are likely still in orbit.*

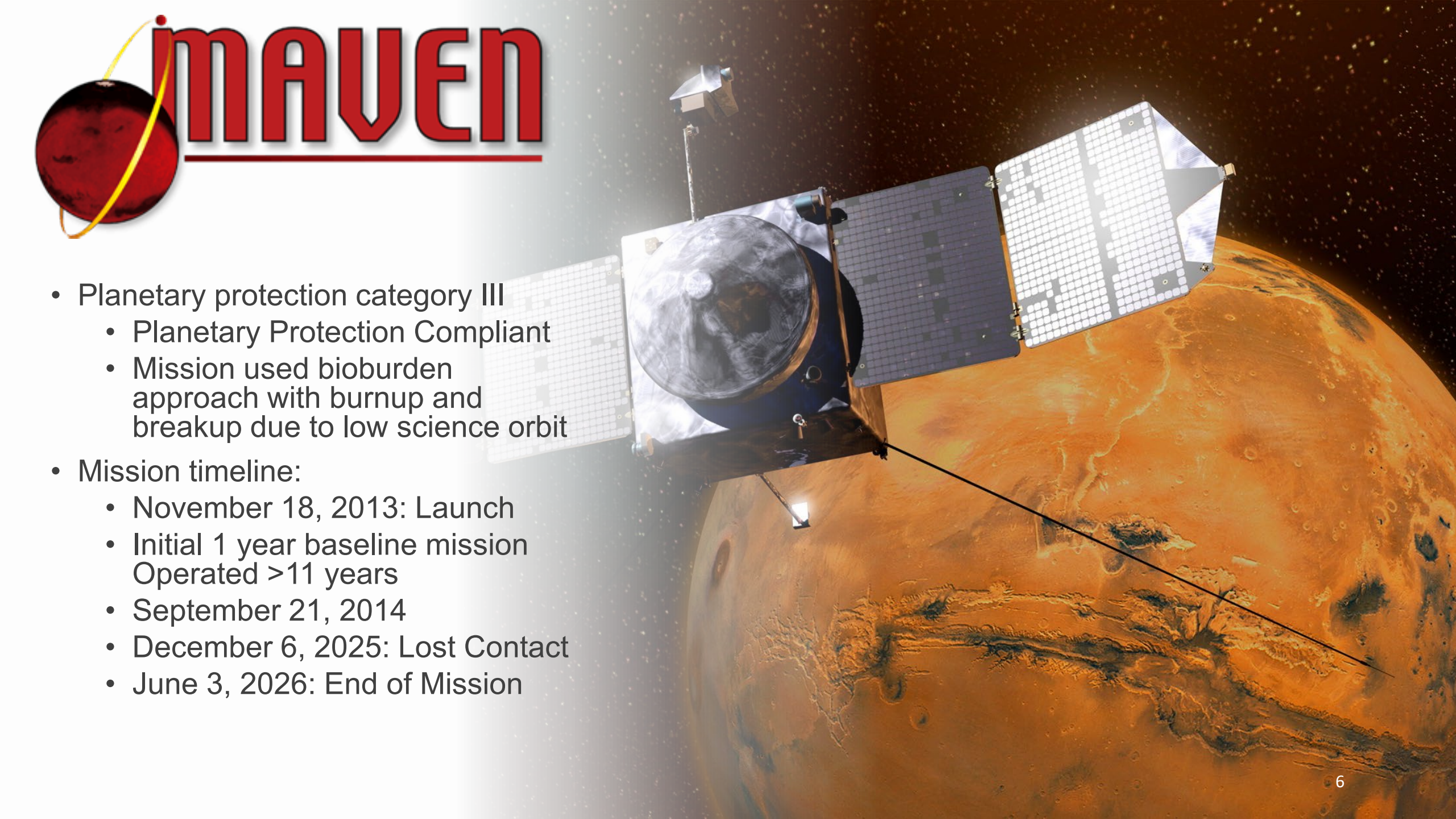




NASA Missions Ended in the Period 2024-2026

- Artemis II- April 2026
- MAVEN- June 2026
- Lunar Trailblazer- July 2025
- CLPS missions: Blue Ghost 1 (January 2025), Intuitive Machines 2 (February 2025)



- Planetary protection category III
  - Planetary Protection Compliant
  - Mission used bioburden approach with burnup and breakup due to low science orbit
- Mission timeline:
  - November 18, 2013: Launch
  - Initial 1 year baseline mission Operated >11 years
  - September 21, 2014
  - December 6, 2025: Lost Contact
  - June 3, 2026: End of Mission

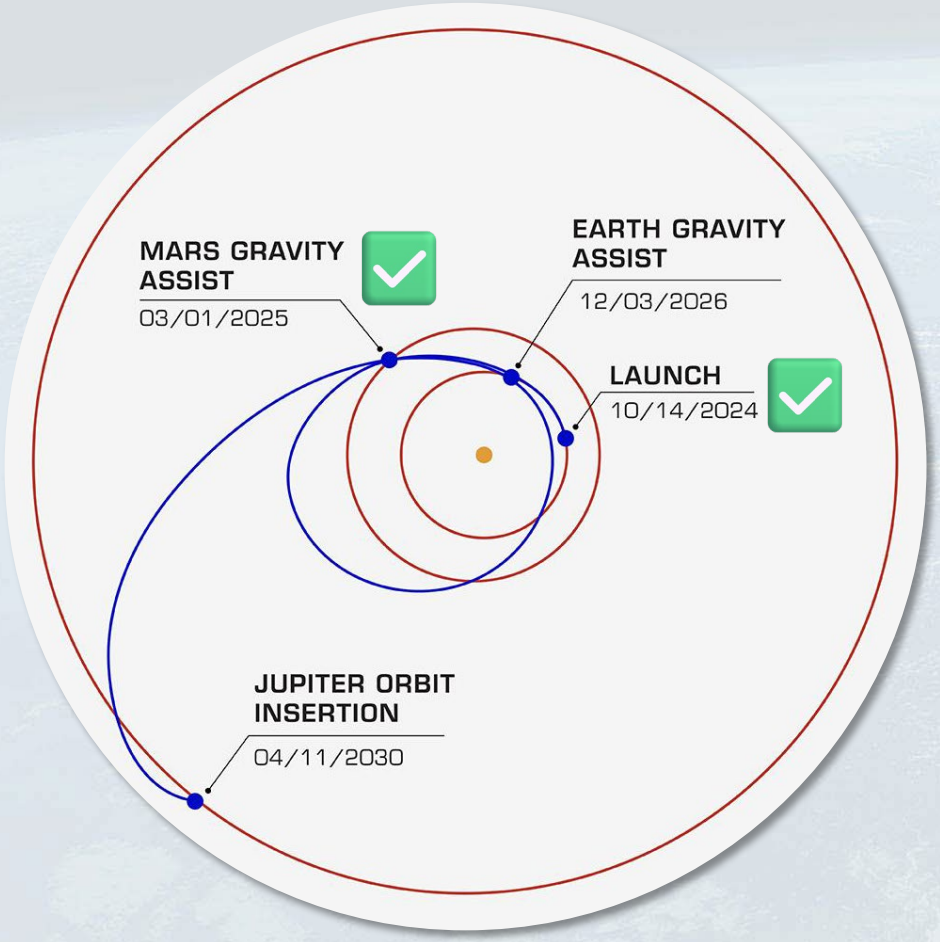
Planetary Protection for Ongoing Missions

- **Solar / Lagrange Point Missions**
  - Global Lyman-alpha Imagers of the Dynamic Exosphere (GLIDE) Category I
  - IMAP – Cat I (L1)
  - Solar Parker Solar Probe – Cat II (Venus flyby completed)
  - JWST – Cat I (L1)
  - SunRISE – Cat I
  - Helioswarm Cat II (Lunar flyby)
- **Lunar Missions**
  - Lunar Reconnaissance Orbiter – Cat II
  - CAPSTONE – Cat II (in partnership with NZ)
  - Artemis III – no PP categorization (Earth Orbiting)
  - Artemis IV+ -- Category IIa or IIb depending on destination
  - HLS – Category IIa or IIb depending on destination, with unrestricted Earth Return
  - **Moonbase Program** – pending categorization, pending Cat IIb
- **Asteroid Missions**
  - OSIRIS –APEX [APophis EXplorer])
  - Lucy – Cat II
  - DART – Cat II
  - Psyche – Cat III (Mars flyby)
- **Jovian Missions**
  - JUNO – Cat III
  - Europa Clipper – Cat III with Mars flyby
- **Mars Missions**
  - Mars Odyssey - Cat.III orbiter in extended mission until 2028
  - Mars Reconnaissance Orbiter - Cat.III orbiter in extended mission until 2028
  - Mars Science Laboratory/Curiosity Rover - Cat.IVa in extended mission until 2028
  - Mars 2020/Perseverance - Cat.IVb (subsystem sterilization) mission, w/ restricted Mars sample return, extended mission to support MSR
  - The Escape and Plasma Acceleration and Dynamics Explorers (EscaPADE), Category III
  - Rosalind Frankling Rover – Cat IVc (in partnership with ESA)
  - MMX – P-Sampler – Cat III, unrestricted Earth return (in partnership with JAXA)
  - **SR-1 Freedom** – Pending Cat III
  - **Skyfall** – Pending Cat IVa
  - Mars Telecommunications orbiter – Pending Cat III
  - Relativity Space Aeolus atmospheric-science instrument payload suite
- **Saturian Missions**
  - Dragonfly –Cat II
- **Other**
  - New Horizons – Cat II (Pluto system)
  - DAVINCI (Venus, Cat II)
  - VERITAS (Venus, pending Cat II, on hold)

*Missions not launched

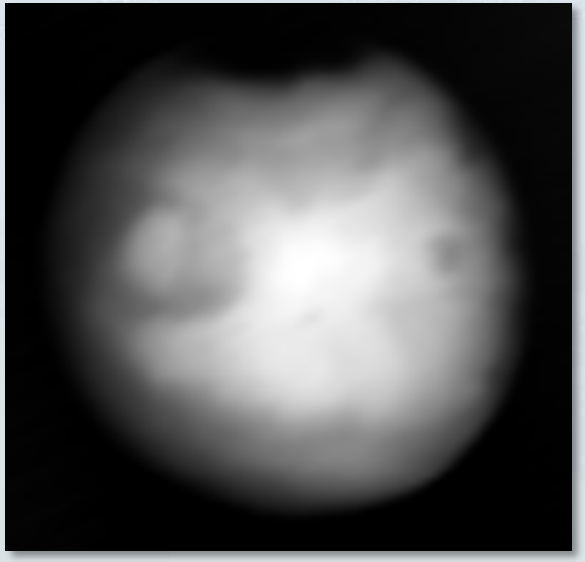
All operating NASA missions continue to be consistent with international planetary protection guidelines and NASA PP Policy.

Europa Clipper



- **Planetary Protection Category III mission**
  - *Probabilistic Risk Assessement and bioburden measurements*
- Launched 10/14/24
- Mars gravity assist 3/01/2025
  - *3 trajectory correction maneuvers leading up to the Mars gravity assist*
  - *Tested 2 instruments and captured an image of Mars in infrared*
- Jupiter Orbit Insertion April 2030





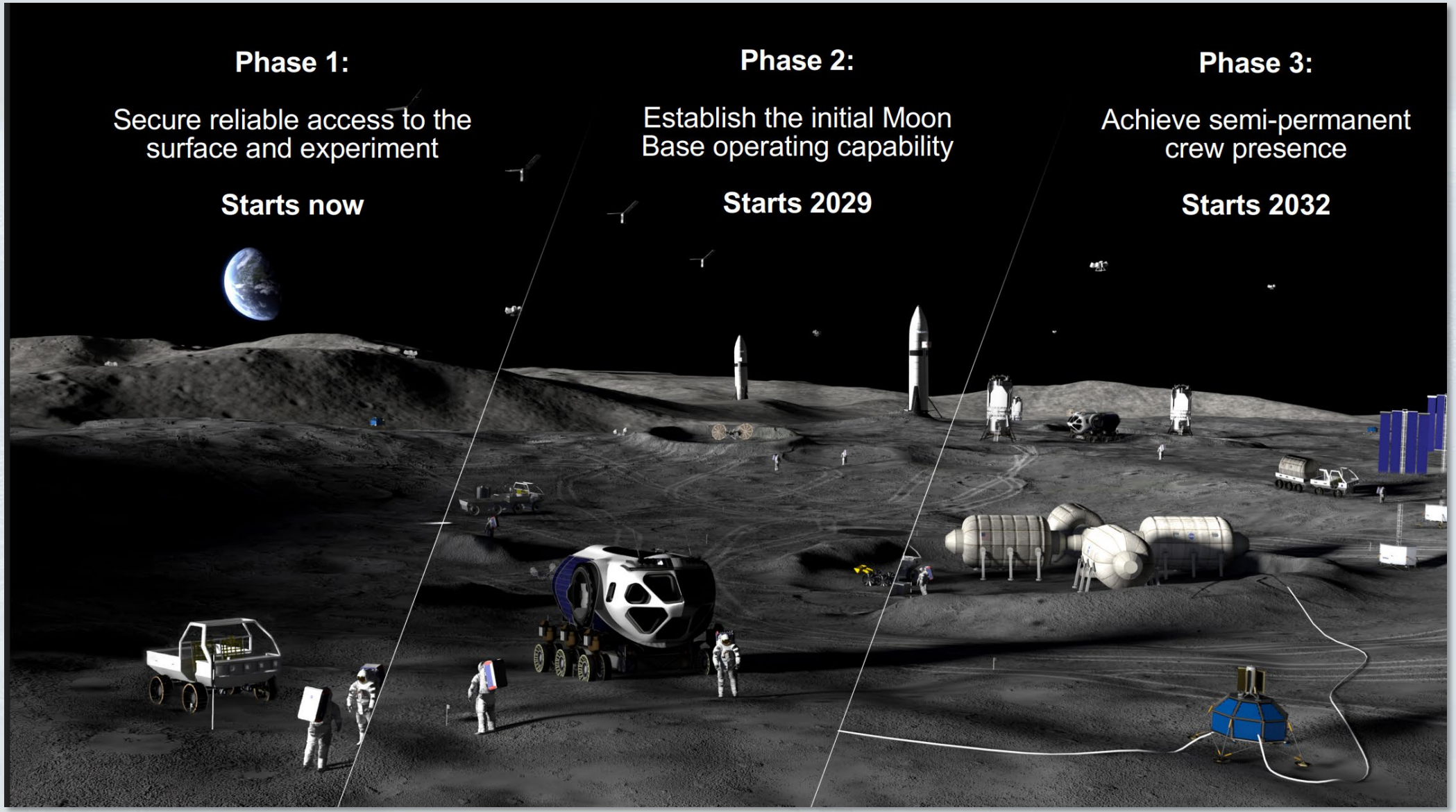
Europa Clipper is compliant with all PP requirements!

Future of NASA exploration with Ignition



- March 24 2026, Ignition event outlined a vision for NASA's next major initiatives
- Going Back To The Moon: Moonbase, Increased Artemis cadence
- Mars Exploration: SR-1 Freedom and Skyfall
- Science missions: Dragonfly, Rosalind Franklin, lunar CLPS
- Low Earth Orbit

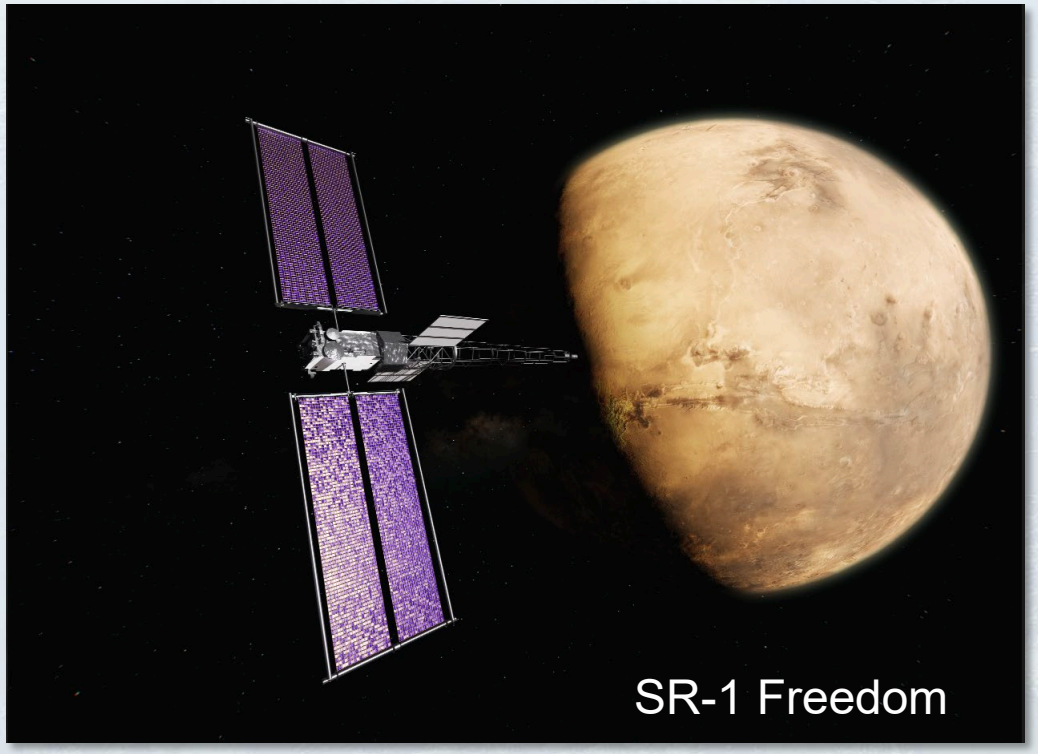
NASA Ignition: Back to the Moon, Artemis and Moon Base Program

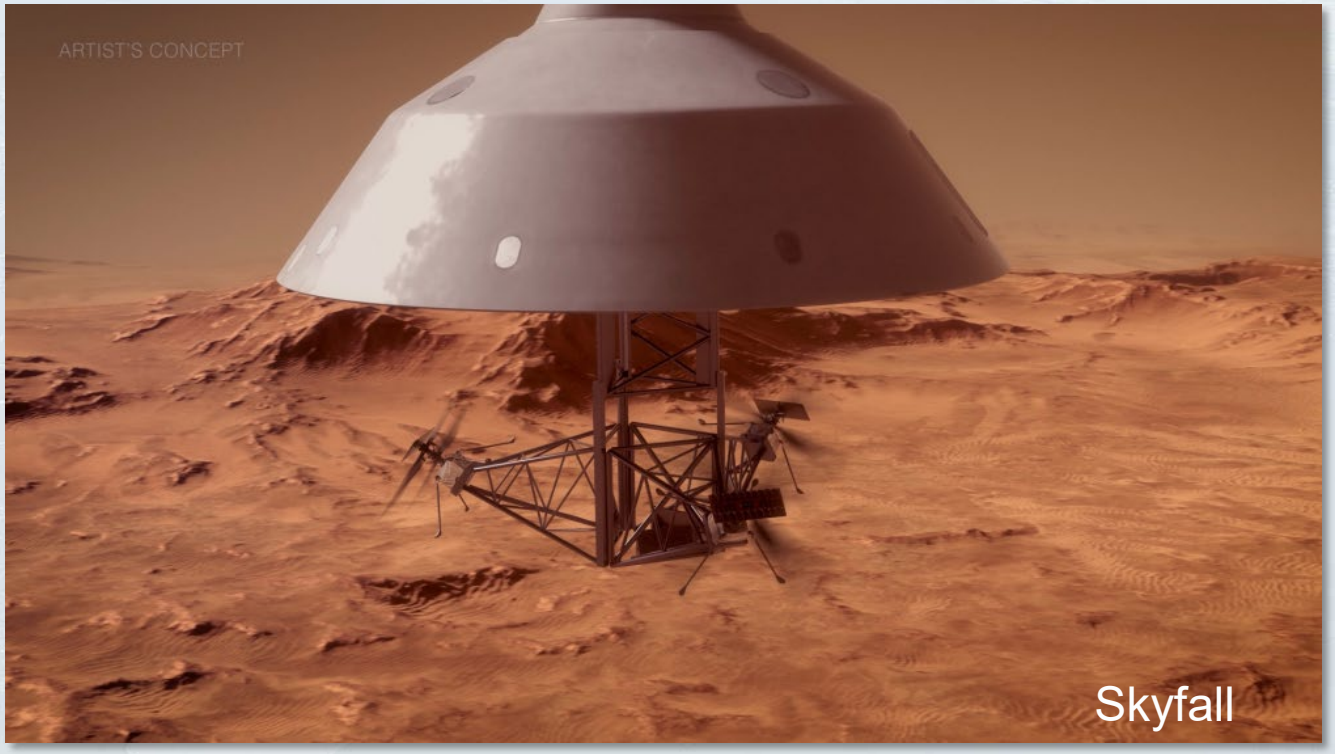


NASA Ignition: Mars, SR-1 Freedom and Skyfall

SR-1 Freedom: Interplanetary spacecraft to demonstrate nuclear electric propulsion in deep space

Pending Category III





Pending Category IVa

Skyfall: Mars helicopters for scientific exploration and scouting

NASA Ignition: Planetary Missions



Planetary Protection Cat II
Dragonfly rotorcraft
Titan

Mars
Planetary Protection Cat IVc
Rosalind Franklin Rover (ESA)



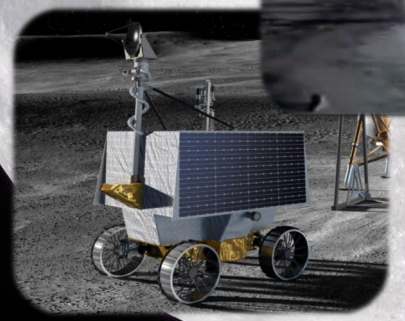
CLPS lunar missions



Moonfall



CADRE



VIPER



NASA continues to monitor its spacecraft from a planetary protection (PP) perspective, to ensure continued compliance with PP requirements throughout the life cycle of the mission.

This presentation serves as a report for PP missions not detailed elsewhere throughout the COSPAR Panel of PP Sessions.

Abstract

NASA monitors its spacecraft from a planetary protection (PP) perspective, to ensure continued compliance with planetary protection requirements. This report to COSPAR on previous, ongoing and future missions will describe the issues and considerations regarding the PP implementation and compliance status of each mission, with changes noted as appropriate from previous reports. Missions not described in other presentations will be covered, including (but not limited to): Europa Clipper, Juno, Curiosity, Perseverance, Mars Atmosphere and Volatile EvolutioN (MAVEN), Mars Reconnaissance Orbiter, Escape and Plasma Acceleration and Dynamics Explorers (ESCAPADE), Dragonfly, Artemis II, and Artemis III.