



Prioritized Technology: Ice Penetration and Sampling – Bioburden Reduction-Tolerant Hardware

Technical Goal

- Development of Ice penetrating and sampling hardware for Ocean Worlds missions that is compliant with planetary protection requirements and tolerant to at least one of the NASA-qualified methods for bioburden reduction.
Example: Europa Clipper mission has a requirement to ensure a $<1 \times 10^{-4}$ probability that a single viable Earth organism remains on the surface of Europa after a possible spacecraft impact, due to the potential for rapid communication between the subsurface and surface of that moon
- Experimental testbeds for validation of complex designs and operational cases that permit design revision prior to flight builds

Mission Applications

What is enabled if we achieve this goal?

Risk reduction of missions with sensitive planetary protection requirements for the following planetary bodies with ice, geysers or other methods of connection between the surface/atmosphere and the subsurface:

- Europa: Clipper, Lander, Sample Return
- Enceladus: Lander Sample Return

Mission designs that include potential to access to COSPAR-designated special regions and recontamination sensitive regions (direct ocean access/drilling) with cost and hardware risk mitigation built in.

Technical Status

Current NASA Methods for Bioburden Reduction: NASA has qualified two approaches for bioburden reduction: (1) Dry Heat Microbial Reduction, (2) Vapor Hydrogen Peroxide; other techniques need investigation (gamma, plasma, etc.)

Overlap of DHMR compatibility with High-Temperature Parts: NASA EEE Parts Selection processes should be evaluated to expand use to MIL-SPEC 810F (High Temperature Compliant) parts as well as Automotive Industry Parts (AEC series), both of which are qualified to operate at temperatures that are much higher

Limited development of system-level techniques: There is a need for integrated/scaled up methods for large-scale bioburden reduction

Development Cost and Schedule