

# Thoughts on suggestions by COSPAR PPP to update the PP policy for Icy Worlds

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# Icy Worlds for PP

# Small bodies for PP

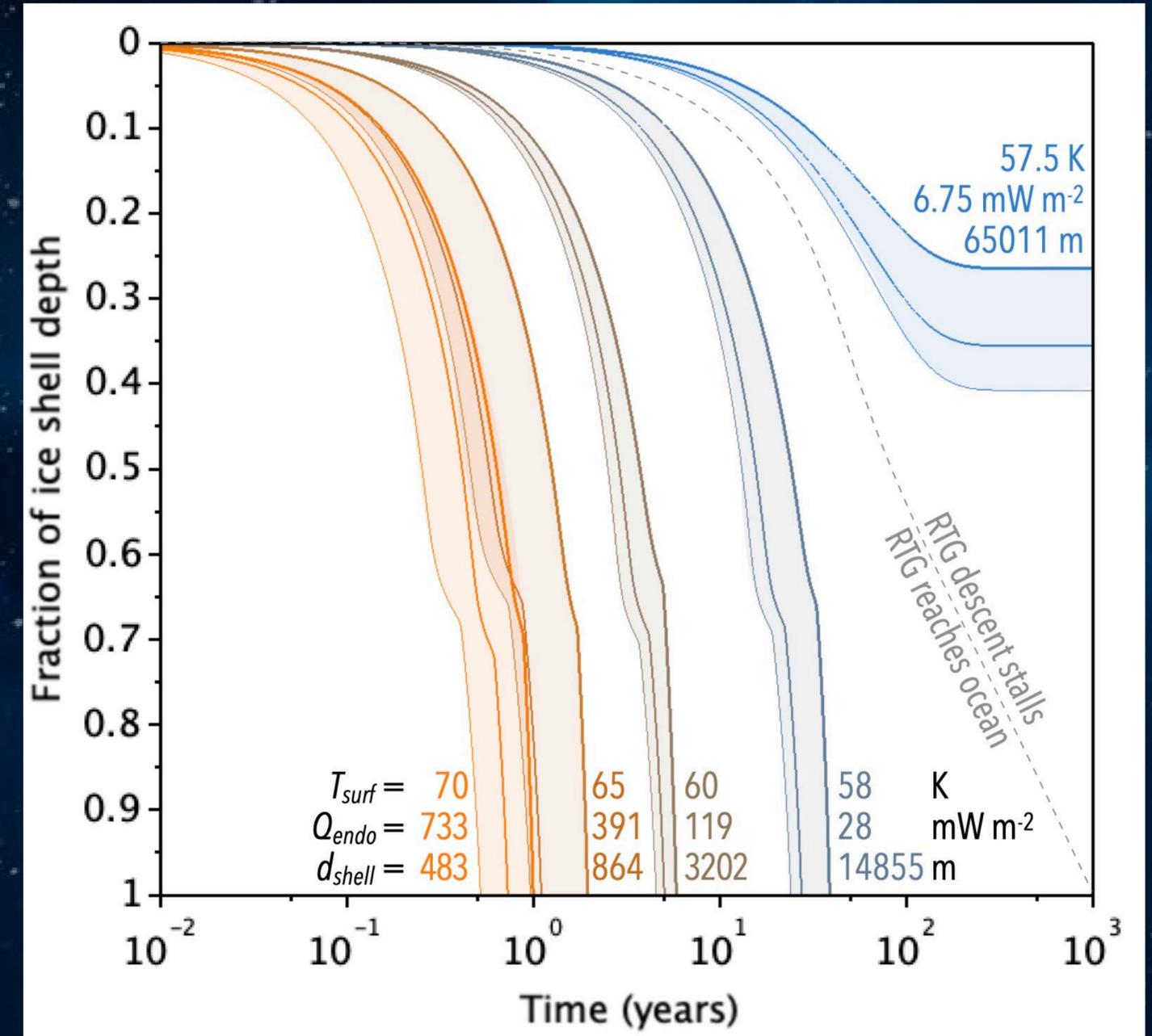
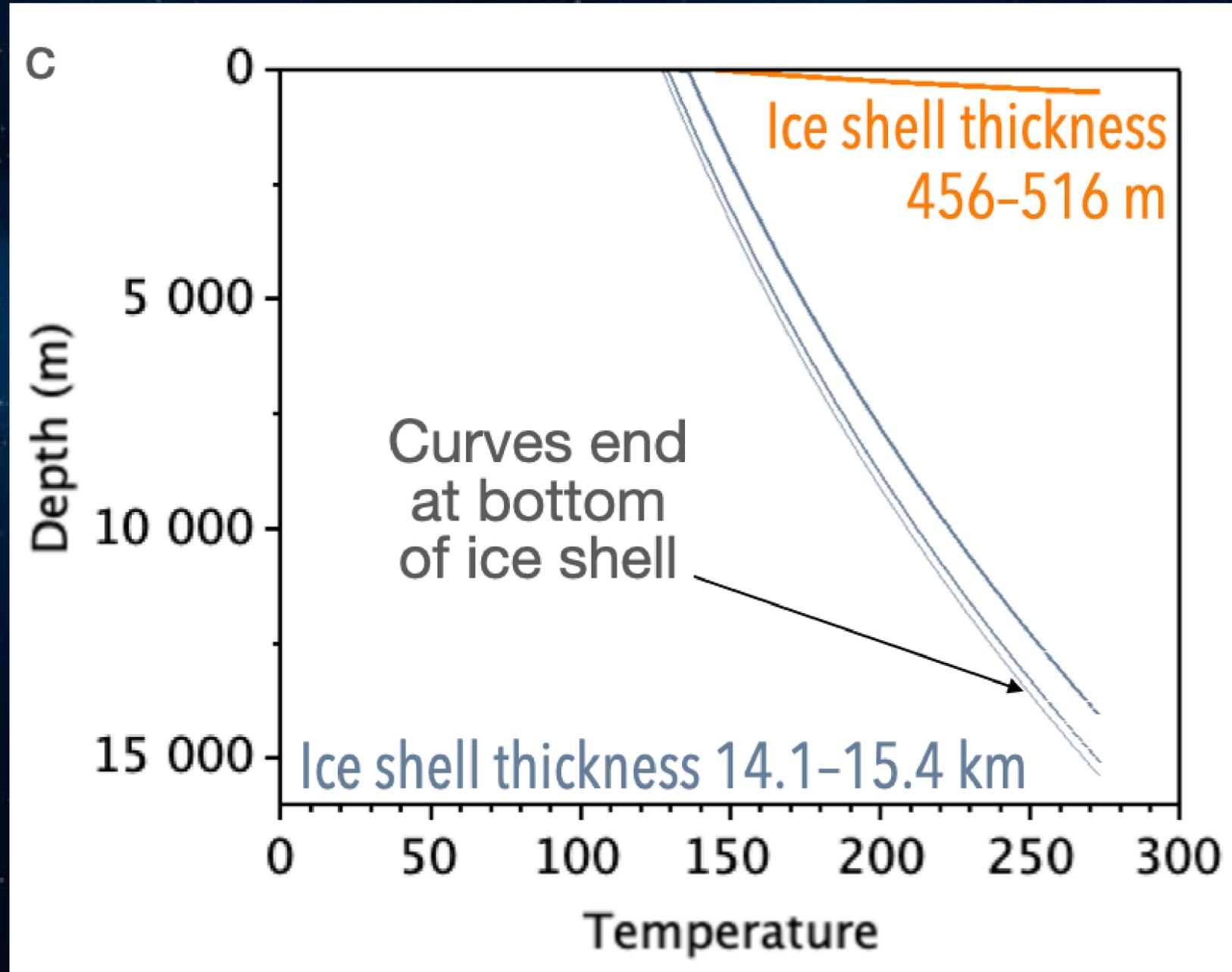


OWL  
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# Reaching environments $>$ LLT in off-nominal cases



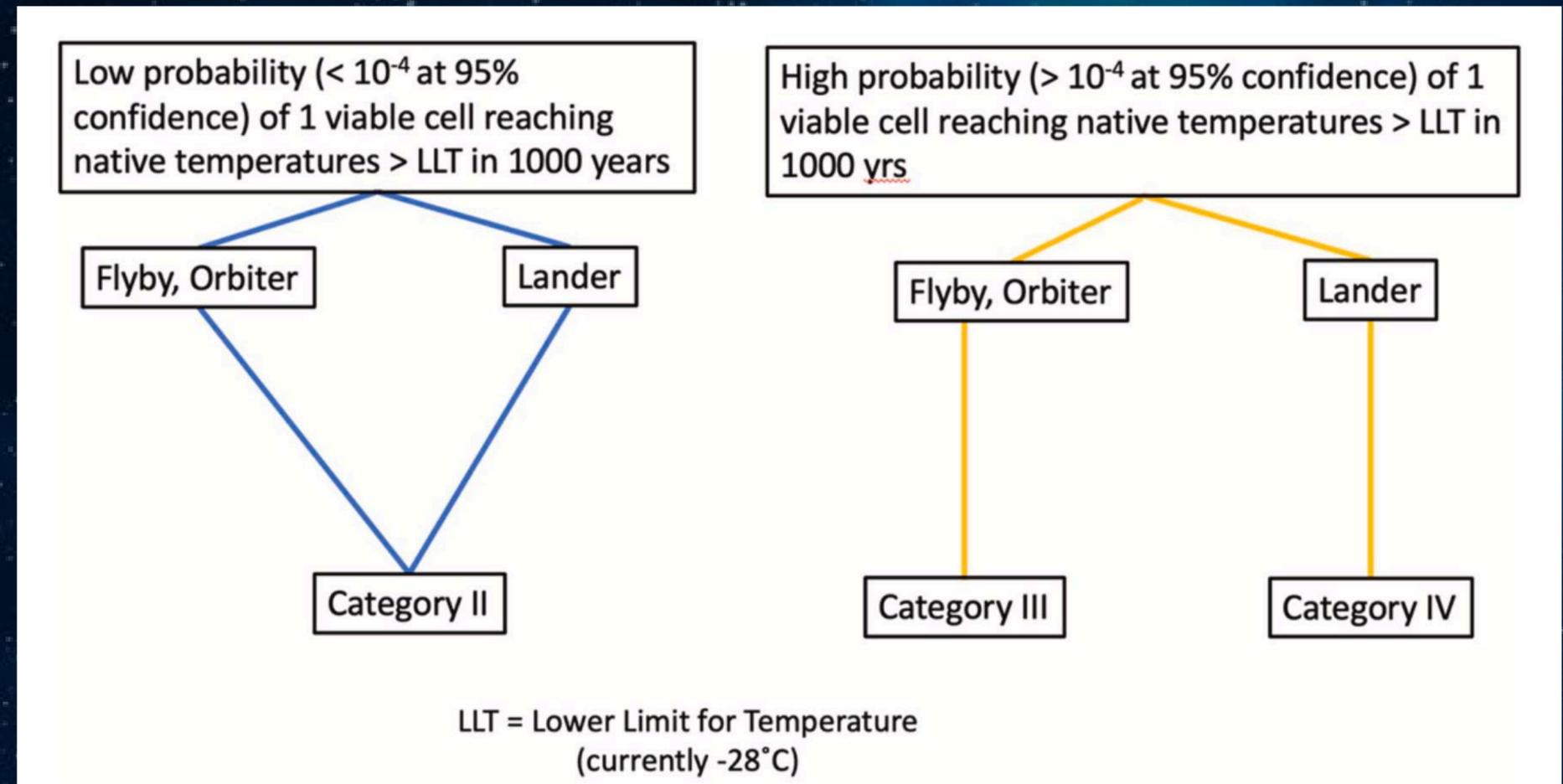
# Cat. V restricted return for Icy Worlds: outbound leg categorization?

## 10.2. Sample Return Missions from Europa and Enceladus

*Category V.* The Earth return mission is classified, “Restricted Earth return.”

- Unless specifically exempted, the outbound leg of the mission shall meet the contamination control requirements given above. This provision should avoid “false positive” indications in a life-detection and hazard-determination protocol, or in the search for life in the sample after it is returned. A “false positive” could prevent distribution of the sample from containment and could lead to unnecessary increased rigor in the requirements for all later Europa or Enceladus missions.

or



## Quantitative fwd PP

$P[\text{inoculation}] < \text{threshold}$

## Qualitative back PP

e.g., no “ $< X$  probability that unsterilized particle  $> X$  size from returned hardware shall enter Earth’s biosphere”



# Summary

- (1) New definition for Icy Worlds for PP: *all bodies with an outermost layer > 50 vol.% water ice and nearly round.*  
What is lost by going down to 20 vol.% and letting Ceres in? Or should Ceres be a “small body” for PP?
- (2) Establish lower limits of Earth life on water activity (LLAw = 0.5) and temperature (LLT = −28°C) for all areas of the COSPAR Planetary Protection Policy.  
OK
- (3) For Icy Worlds missions:  $P < 10^{-4}$  of single viable microbe reaching environment for 1000 yr with  $T > LLT \Rightarrow$  Cat. II, else Cat. III (orbiter) or IV (lander).  
“of a single microbe” -> “of an inoculation event”? (*L. Pratt public presentation to Decadal OWDP panel on 2/5/2021, Draft PP Standard 4.6.4.1*)
- (4) Have all missions consider possibility of impact. Transient thermal anomalies due to impact acceptable if (3) is met.  
OK, see Neveu et al. (2022) for quantitative evaluation of off-nominal scenarios enabling descent to environments > LLT for Enceladus Orbilander.
- (5) Restructure or remove Category II\* from the policy; redundant with new approach  
I agree that a more streamlined policy is helpful.
- (6) Establish that any sample return from an Icy World should be Category V restricted Earth return.
  - Category of outbound leg? Policy for Mars, Europa, and Enceladus missions: Cat. V restricted  $\Rightarrow$  Cat. IV outbound “unless specifically exempted”. Same for Icy Worlds? Or would outbound leg categorization depend on Fig. 4 framework?
  - Inconsistency between quantitative fwd PP ( $P[\text{inoculation}] < \text{threshold}$ ) vs. qualitative back PP policy (e.g., no “< X probability that unsterilized particle > X size from returned hardware shall enter Earth’s biosphere”). Would help to quantify what is achievable and acceptable. MSR CCRS hindsight?