2017 IEEE Aerospace Conference

A Water Rich Mars Surface Mission Scenario

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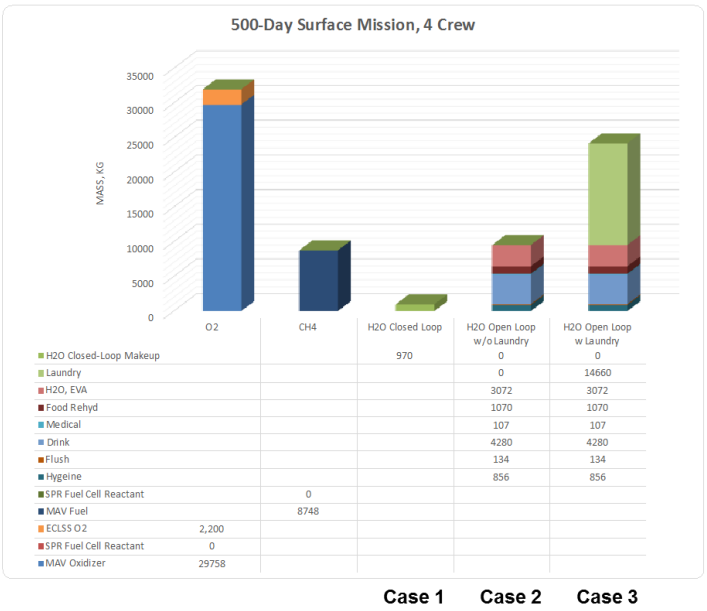
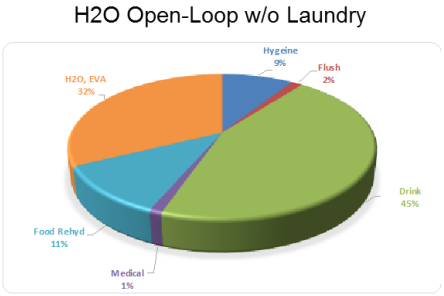
Abstract

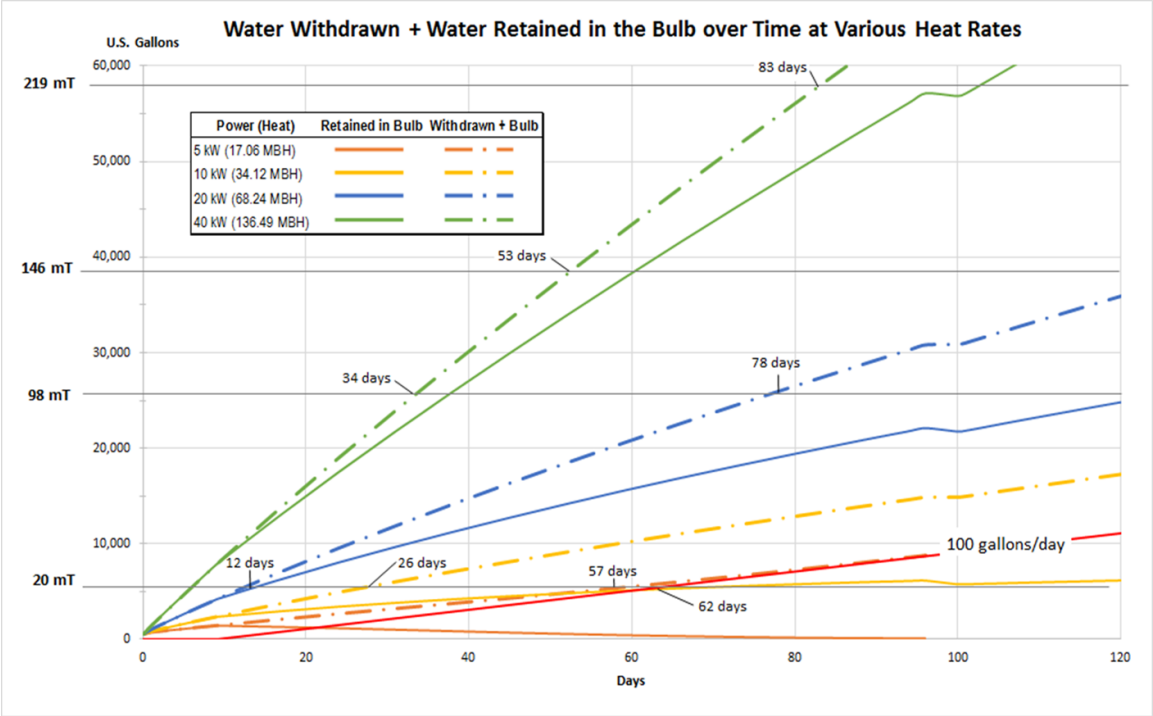
The surface of Mars once had abundant water flowing on its surface, but now there is a general perception that this surface is completely dry. Several lines of research have shown that there are sources of potentially large quantities of water at many locations on the surface, including regions considered as candidates for future human missions.

Traditionally, system designs for these human missions are constrained to tightly recycle water and oxygen, and current resource utilization strategies involve ascent vehicle oxidizer production only. But the assumption of relatively abundant extant water may change this. Several scenarios were constructed to evaluate water requirements for human Mars expeditions to assess the impact to system design if locally produced water is available. Specifically, we have assessed water resources needed for 1) ascent vehicle oxidizer *and* fuel production, 2) open-loop water and oxygen life support requirements along with more robust usage scenarios, and 3) crew radiation protection augmentation. In this assessment, production techniques and the associated chemistry to transform Martian water and atmosphere into these useful commodities are identified, but production mass and power requirements are left to future analyses. The figure below illustrates the type of water need assessment performed and that will be discussed.





There have been several sources of feedstock material discussed in recent literature that could be used to produce these quantities of water. This paper will focus on Mars surface features that resemble glacier-like forms on Earth. Several lines of evidence indicate that some of these features are in fact buried ice, likely remnants from an earlier ice age on Mars. This paper examines techniques and hardware systems used in the polar regions of Earth to access this buried ice and withdraw water from it. These techniques and systems will be described to illustrate options available. A technique known as a Rodriguez Well is assessed as a likely method for extracting water from these bodies of ice. The figure below is a sample of results from this assessment that will be discussed.



Results from this assessment indicate that contemporary hardware systems and the Rodriguez Well technique can be applied on Mars with the resources of mass and power typically available for these human surface missions.

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