Planetary Protection Considerations in EVA System Design

Dean B. Eppler, Mail Code KX, NASA-Johnson Space Center, 2101 NASA Parkway, Houston, TX, 77058 and Joseph J. Kosmo, Mail Code EC5, NASA-Johnson Space Center, 2101 NASA Parkway, Houston, TX, 77058

Planetary protection contamination issues pertaining to forward and back contamination are critical for the design of advanced pressure garments and life support systems. The most important consideration is that pressure systems, of necessity, leak. Leak rates, based on experience with multiple pressure garments, are expected to be 1,500 – 2000 sccm/min. Consequently, gasses, aerosols and microscopic particulates will exit through suit joints, hardware fittings and other interfaces. Trace contaminants escaping will include NH_4, CH_4 and organic compounds, as well as body oils, dander, and microbes. In addition, nominal airlock pump efficiency will result in a loss of ≈0.5-1 kg per airlock cycle.

Each of these leak paths provide an opportunity for forward biological contamination. These issues may be mitigated by minimizing surface contact area of initial human-EVA supported activities through the use robotic precursors to survey intended EVA worksite locations and potential science way-point stations prior to human occupation of a given site, identifying “safe” and “no-go” zones within a predetermined radius of lander/habitat location. However, this will not exclude chance encounters biologically favorable locations.

In terms of back contamination, extended EVA operations will expose exterior suit surfaces to external particulates, such as soil and native volatile species. Use of removable, disposable covers and suit port/lock designs that isolate EVA

hardware from the human-occupied area may limit (although not likely eliminate) external materials in the human habitat.

Definition of “design-to” requirements is critical to understanding technical feasibility and costs. The definition of Planetary Protection needs in relation to EVA mission and system element development cost impacts should be considered and interpreted in terms of “Plausible Protection” criteria. Since EVA operations will have the most direct physical interaction with the Martian surface, “PP” needs should be considered in the terms of mitigating hardware and operations impacts and costs.