NASA SBIR 2018 Phase I Solicitation

H4.03 Mass Produced, Minimal Capability, Disposable EVA Life Support System

Lead Center: JSC

Technology Area: TA6 Human Health, Life Support and Habitation Systems

NASAâ€™s plans for Exploration EVA Operational Concepts and Architectures currently lead to conceptual design solutions optimized for relatively long EVAâ€™s and extensive re-use of the PLSS over the course of many missions.Â From an economics perspective, that is one way to solve the question of â€œvalueâ€ â€“ by amortizing the development and manufacturing cost of a relatively small amount of production units across a relatively long period of use (many years, many EVAs or many separate missions).

However, it is possible that alternative ways of solving the Suit and PLSS problems, including cost, could be acceptable â€“ by reducing the capability inside the EVA PLSS to a point where it might only enable a relatively short EVA (perhaps ~2 hours instead of ~8) and relatively few EVAs (perhaps ~10 instead of ~100) one might be able to construct a schematic and design that was affordably â€œmass producedâ€.

Embracing innovative suit garment technologies and concepts such as novel material layups, Â self-healing/self-repair bladders and restraints, Shape Memory Alloy (for adjustable sizing and fit geometry, ballistic projectile mitigation (for secondary eject from MMOD strikes on nearby natural surfaces), electrochromics, Mechanical Counter Pressure (MCP) concepts, and hybrid designs and manufacturing approaches may lead to cost effective suits that could inform NASA future plans as well as support future commercial space needs.Â Ultimately, concepts, technologies and design solutions leading to the capability of â€œlow-cost customizationâ€ is vital to NASAâ€™s future exploration capabilities in many ways.

The potential benefits of these approaches could include the ability to more regularly incorporate emerging technologies and minor feature updates to continuous reduction of cost through refinement and modernization of the production system.Â Such an approach might also stimulate or otherwise support the adoption of EVA as a viable, cost effective feature in commercial spaceflight systems for non-NASA customers.

Design solutions might look significantly different from current/historic EVA PLSS and suit designs, including features similar to the emergency breathing systems used for short periods by firefighters, first responders and Hazardous Material teams.Â Parallels with such terrestrial applications offer opportunities for existing commercial product lines to be adapted or modified for the â€œhazardous environmentâ€ of EVA and could further grow existing sectors of the economy.Â Such innovative design solutions would also provide NASA technical data that NASA could then integrate into analysis of alternative â€œMission Designâ€ scenarios where the total spaceflight architectural impact of mass, volume, reliability, spares and contingency scenarios are assessed.Â These types of analysis currently only use the conventional PLSS design solution parameters as inputs, but running the same models by adapting Operational Concepts to use a â€œmass producedâ€ EVA PLSS might reveal surprising alternative approaches that

NASA should be aware of.

Phase I products:

- A paper report on the concept highlighting the designâ€™s minimal capabilities.
- A manufacturability analysis explaining why it is mass-producible at an extremely low cost (including an estimate of the number of units needed to achieve a minimal unit price).
- A comparison of the proposed concept with existing commercially available terrestrial life support systems such as firefighter breathing apparatusâ€™:Â
    - The comparison highlights commonality or differences in the technical design and the economies of scale found in available terrestrial life support systems and the proposed concept.
    - This information should clearly support the manufacturability analysis by providing evidence to the costs of existing product lines and why those are relevant analogies to the proposal.
- Prototype suit subsystem manufacture, up to and including a full suit, which could be used in testing.

Phase II would require the product development, further characterization of the limits of the designâ€™s performance and additional financial analysis on the cost of mass production.