NASA SBIR 2015 Phase I Solicitation

H4.01 Crew Survival Systems for Launch, Entry, Abort

Lead Center: JSC

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This subtopic seeks technology innovation supporting the launch, entry, and abort (LEA) crew survival equipment needs for future human exploration beyond low-earth orbit. Primary goals include development of technologies enhancing crew survival in the launch, entry, and abort phases of flight as well as the post-landing environment, significant mass reduction of hardware, and development of space-qualified survival hardware technologies designed to operate after exposure to space vacuum and thermal effects. LEA crew survival equipment development is a critical need tied to any future manned Design Reference Mission (DRM) laid out by the agency, as well as providing benefit to both Orion/MPCV and Commercial Crew Program engineering efforts. Many candidate technologies will have direct application to Orionâ€™s EM-2 mission and follow on manned spaceflight activities.

Systems and technologies relating to enhancement of post-landing survival and rescue following manned exploration spacecraft launch, entry, and abort (LEA) events are sought in the following areas:Â

- *Lightweight Survival Life Raft Materials, Construction Methods, and Related Technologies* - Programmatic need exists for a low mass, self-inflating life raft under 30 lbm. Technologies should be directed to enable crew survivability in the post landing off-shore ocean environment meeting SOLAS and/or FAA standards and Orion/MPCV Design Specification for Natural Environments (DSNE) sea state definitions while meeting a 30 lbm mass constraint. Of particular interest is significant mass reduction in raft inflation systems, innovative construction techniques and techniques / methods for enhanced operability by long-duration spaceflight de-conditioned crew members. The current space equivalent baseline is an FAA six person raft. Currently this type of raft does not exist without â€˜breakingâ€™ the 30 lbm mass requirement or sacrificing survivability attributes. Efforts should focus upon novel lighter weight materials and constructions methods, as well as inflation systems. Another area of concern from the medical community is raft ops and ingress by deconditioned crew members experiencing neurovestibular effects of long-duration spaceflight.
- *Suit-Integrated Global Coverage Personal Locating Technologies* - Current commercially-available Personal Locating Beacons (PLBs) are not optimized for use in the manned spaceflight thermal and vacuum environment or integration into a survival suit cover layer. Innovative technologies/efforts should be directed towards novel flexible patch antenna development, robust beacon packaging technologies, analytical methodology for integrated beacon operational analysis, and beacon triggering (RF, saltwater, etc.) technologies. Additionally, there is interest in prototype electronics board development for use with future satellite-based GPS/Doppler locating systems such as the NASA-led Distress Alerting Satellite System (DASS). This technology development subheading also includes development of high-reflectivity materials in the visible, IR, and radar wavelengths.
- *Occupant Protection Materials, Analytical Tools, and Technologies* - Products and materials leading to

enhanced occupant protection in the capsule landing loads environment. Innovative technologies and efforts should be directed towards acceleration, vibration, and impact attenuation systems designed to mitigate dynamic flight event impacts on the crew member. Of potential interest are materials and products to protect crew members from head and neck injuries during landing load shocks. Additionally, technologies such as innovative restraint mechanisms preventing crew member flail and flail-related injuries during dynamic flight events are of potential interest. When considering impact attenuation material properties, attention should be paid to preventing crew member exposure to rate changes of acceleration greater than 500 g/s. Material space-rating requirements should be taken into account in relation to the manned spaceflight thermal / vacuum environment. Within this subtopic, analytical methods should be directed to prevention of extremity flail, head, and neck injuries during linear, vibrational, and angular acceleration events.

- *In-Suit Waste Management Technologies* **-** Development of technologies allowing for long-duration waste management for use by a pressurized suited crew member. In the event of cabin depressurization or other contingency, crew members may need to take refuge in LEA pressure garments for a long-duration (144-hour) return trajectory back to Earth. Technology development should be tailored to a 144-hour suited contingency, meeting the NASA Human Systems Integration Requirement (HSIR) inside an LEA suit pressurized to 4.3 PSID referenced to the ambient environment. Waste management technologies should address fecal and urine waste containment and human physiological responses / countermeasures to long duration waste management in a pressurized survival suit environment from one to six days. Advanced technologies and materials should ideally provide for urine collection of up to 1L per day per crew member, for a total of 6 days. Additionally, mitigation and/or elimination of urine-generated ammonia inside the pressure garment volume is a candidate area of interest. Fecal collection rates should be targeted for 75 grams of fecal mass and 75 mL fecal volume per crew member per day for a total of 6 days duration.

Research done in Phase I of these efforts should focus on technical feasibility with an emphasis on hardware development that can be further expanded in a future Phase II award cycle. Phase II products must include a demonstration unit suitable for testing by NASA. Prototyping should be tailored to applications to ongoing HEO Mission Directorate missions and possible collaborative use in both the governmental and commercial manned spaceflight disciplines. Minimum deliverables at the end of Phase I are analysis and/or test reports, with priority given to functional hardware prototypes for further evaluation. Technical maturation plans should be submitted with Phase I submittals, as well as any expected commercial applications both internal and external to the manned spaceflight enterprise.