NASA STTR 2016 Phase I Solicitation

T6.04 Closed-Loop Living System for Deep-Space ECLSS with Immediate Applications for a Sustainable Planet

Lead Center: ARC

NASA's plans to explore space beyond Low Earth Orbit will push the performance of life support systems toward closed loop living systems. Deep space missions will require life support systems that will be self-sustaining since we cannot expect to carry enough spares and consumables for year-long missions. Achieving the development of such systems will provide the understanding for managing limited availability of resources. The parallel with earth planetary resources management is ideal as the world population grows and resources and infrastructure availability decreases. We expect that technologies developed for closed loop living systems will be immediately available and applicable to provide planetary sustainability as well.

State of the Art

An immediate example of such endeavors exists in the form of the NASA Ames Sustainability Base where technologies for deep space exploration have been used to create one of the greenest buildings in the federal building inventory. These technologies include power generation with fuel cells, water recovery systems, advanced HVAC, environmental control, recyclable materials and use of local resources. Even though these technologies are readily available for deep space travel, each has its own set of challenges for adaption to earth application along with integration challenges.

Closed-loop living systems are mostly based on the thermodynamics laws of the conservation of mass and energy. We expect to maximize the conservation so that only a minimal amount of resources needs to be taken on a deep space mission.

Innovations are sought to enable:

- Transfer of deep space exploration technologies to earth applications.
- Development of integrated self-sustainable systems.
- Development of the most effective processes to allow for closed loop living applications.
- Application to so-called "off-the-grid" habitation in remote areas where infrastructure is inexistent.

Potential deliverables may include a demo of ECLSS concept(s) with clear applications to earth, enhanced control techniques of multiple life support subsystems (e.g., environment, water recovery, power usage, etc.), or prototype hardware and/or software to enable sustainability.