



## NASA SBIR Select 2015 Phase I Solicitation

### Human Exploration and Operations

Human Exploration and Operations Mission Directorate Select Subtopics Topic H20 Sub Topics:

#### H20.01 Solid and Liquid Waste Management for Human Spacecraft

Lead Center: JSC

Participating Center(s): ARC, KSC, MSFC

Innovations are needed in management of solid and liquid wastes to increase closure of ECLS systems by further recycling of water and to increase stability of wastes on long duration human exploration missions. Management systems are needed to enhance collection and safe handling of wastes and allow for robust means of water recovery and storage. Traditionally collection and processing are treated as discrete systems that require significant crew interactions and equipment/consumables to allow water recovery. Future space craft will have limited volume and management of human and life support wastes must be improved. Waste management gaps exist in processing fecal waste, trash, hygiene waste, and residual urine brines (85% of water removed). Future waste systems should utilize features that do not require dynamic liquid separation, are highly tolerant of precipitation and solids accumulation, have limited crew interaction, and minimize off gassed compounds during processing or storage. Processing technologies should recover thermal energy where feasible and be able to operate with irregular time intervals or long quiescent periods between waste inputs. Waste management components and systems are desired to enhance, improve, or integrate existing HEOMD and STMD technologies such as the Universal Waste Management System (toilet), Heat Melt Compactor (solid waste processor that can heat compact and provide water recovery), Urine Processing Systems (Cascade Distillation, Vapor Compression Distillation), and Brine processors. Proposals in the following key technologies are requested.

#### Human Solid Waste Management

Human fecal waste (mixed solid, diarrheal, wipes, and hygiene products) is currently entrained with air and collected into bags which are stored in rigid containers. The rigid containers require significant logistical volume and do not allow water recovery. There is a need for collection bags and containers that require minimal crew manipulation and allow or facilitate the recovery of water from the mixed solid waste. The bag, container, and processing components must allow recovery of greater than 90% of the water, control odors, and prevent microbial releases beyond the container during and after processing. Specific challenges include components for urine and fecal odor control, water condensation and separation of high organic/high microbial population fluids, and minimal consumable mass per defecation. Commonality or capability to process mixed non-human solid waste or brine waste is desirable but not required.

#### Water Recovery from Brine

Brine is currently produced as the concentrate from distillation of urine and humidity condensate. Future mission wastewater could include hygiene and laundry sources. Brines may contain about 15% dissolved solids at a pH of about 2 with hazardous treatment chemicals such as oxone, sulfuric acid, and chromic acid, depending on pretreatment chemicals used. Processes are desired that can recover roughly 90% of the residual water from the brine while containing the hazardous brine residual and avoiding risk of residual release to the cabin.

*Phase I Deliverables* - Detailed analysis, proof of concept test data, and predicted performance. Deliverables should clearly describe and predict how performance of targeted spacecraft and commercial systems are enhanced, improved, or integrated with the proposed technology.

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*Phase II Deliverables* - Delivery of technologically mature components/subsystems that demonstrate physical processes are required. For NASA applications, near flight-like configuration is requested. Hardware designs should allow integration to or with the above NASA systems, compatible with resources from an EXPRESS rack or similar ISS facility. Systems requiring resources significantly beyond the capability of an ISS EXPRESS rack are not desired without clear identification of a significant performance benefit. Although suitable for commercial applications, delivery of a standalone ground-based Benchtop subsystem would not be appropriate for flight applications unless justified.

#### Solid and Liquid Waste Management for Human Spacecraft Topic H20.01

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