NASA SBIR 2008 Phase I Solicitation

X3.01 Lunar Regolith Excavation and Material Handling

Lead Center: JSC

Participating Center(s): GRC, KSC

The lunar regolith excavation, handling, and material transportation subtopic includes all aspects of lunar regolith handling for oxygen and other resource collection and site preparation and Outpost infrastructure emplacement, including tasks such as clearing/leveling landing areas and pathways, buildup of berms and burying of reactors or habitats for radiation protection. Excavation capabilities may involve excavation and collection of both unconsolidated and consolidated surface regolith. Hardware must be able to operable over broad temperature ranges (generally 110K to 400K) and in the presence of abrasive lunar regolith and partial-gravity environments. Expectations for maintenance by crew must be minimal and affordable. Therefore, general attributes desired for all proposed hardware include the following: lightweight, abrasion resistant, vacuum and large temperature variation compatible materials, low power, robust/low maintenance, and minimize dust generation/saltation during operation. Specific software and hardware for insertion into on-going ISRU Project development and demonstration activities include:

- Excavation hardware for oxygen production: Unconsolidated material, 17 kg/hr based on hydrogen reduction, <10 cm deep; avoid or mitigate rocks >5 cm diameter (See note on mobility platform below).
- Excavation hardware for deep digging: Consolidated material, 3 m deep and 1 meter in diameter at a minimum; (See mobility platform note below).
- Granular materials mixing and separation for reactor feedstock conditioning: remove material > 0.5 cm diameter before dumping into storage bin during excavation operation for oxygen extraction from regolith.
- Dust tolerant, lightweight mechanisms and actuators for excavation and material transport operations.
- Site preparation hardware, automation, and control for surface contouring and area clearing and leveling.
- Site preparation hardware, automation, and control for berm building; 3 meters tall; 45 degree slope minimum based on landing plume mitigation.

Phase 1 proposals should demonstrate technical feasibility of the technology and/or subsystem through laboratory validation of critical aspects of the innovation proposed, as well as the design and path toward delivering hardware/subsystems in Phase 2 for incorporation into existing development activities.

Proposers are encouraged to use the Lunar Sourcebook at a minimum for understanding lunar regolith material parameters in the design and testing of hardware proposed. To determine implement size and time required to complete tasks, proposers have three options for surface mobility: 1) part time use of NASAâ€™s large crew rover currently under development (2000 kg mass, 1.33 m wide, 4.5 m long, and 0.2 m high chasse frame, 0 to 0.67 m frame height variation capability from surface), 2) operation on a smaller dedicated ISRU rover yet to be developed, 3) optimize vehicle size to minimize total system mass and power. For option 2, interface requirements for on-going development efforts will be provided after selection. For option 3, proposers may evaluate surface mobility aspects in their proposal but cannot exceed 35% of the budget for the proposed effort.Â