NASA SBIR 2008 Phase I Solicitation

X3.03 Lunar ISRU Development and Precursor Activities

Lead Center: JSC

Participating Center(s): GRC, JPL, KSC, MSFC

The ISRU Project has initiated development and testing of hardware and systems that can achieve early lunar Outpost needs with respect to oxygen (O_2) production from regolith and site preparation and outpost infrastructure emplacement. However, before ISRU hardware will be built and deployed on the lunar surface for Outpost operations, ISRU concepts and operations will need to be anchored through computer modeling, evaluated under simulated lunar environmental conditions (1/6 g and vacuum), and possibly on precursor flight missions. Secondly, before outpost emplacement occurs and O_2 production from lunar regolith begins, detailed knowledge of the terrain, local minerals, and potential resources is important for planning and operations at the start of establishing long-term Outpost capabilities. Lastly, while the other two ISRU subtopics are specifically aimed at increasing the fidelity and performance of on-going development activities at a scale appropriate for early lunar Outpost needs, it is recognized that evaluating the feasibility and benefits of other technologies and concepts not ready for insertion into these efforts should be pursued. With these objectives in mind, this subtopic is aimed at providing development support capabilities, sub-scale or precursor hardware that can be evaluated under simulated lunar environmental conditions (1/6 g and/or vacuum), and advanced ISRU concepts not ready for incorporation into current ISRU system laboratory and field test activities. Proposals aimed at the following are of particular interest:

- Computer models to predict excavation-tool soil interaction and flow behavior of lunar regolith under vacuum conditions and 1/6 g for hardware design and performance prediction.
- Vacuum compatible geotechnical instruments to verify soil bin characteristics; instruments that can be mounted and operated from rovers for field testing are also of interest.
- Mineral beneficiation concepts to separate iron oxide-bearing material from bulk regolith; up to 20 kg/hr based on hydrogen reduction. Hardware/concepts need to be designed for compatibility with both 1/6 g flight experiments and ground vacuum experiments.
- Lunar regolith storage and granular flow devices and instruments to evaluate and characterize regolith behavior under 1/6 g flight and ground vacuum experimental conditions.
- Advanced excavation implement concepts and hardware that can utilized to evaluate implement/soil interaction characteristics under 1/6 g flight and ground vacuum conditions.
- Development of specialty lunar simulants for beneficiation and microwave processing of lunar regolith;

proposals must estimate production costs per kilogram by end of Phase 1.

- Lunar surface stabilization and regolith binding methods (including but not limited to sintering and melting) for level areas and trench/berm walls; bearing strength and smoothness requirements are not currently established but should be considered in the proposal.

- Processing concepts for production of carbon monoxide, carbon dioxide, and/or water from plastic trash and dried crew solid waste using solar thermal energy; in situ produced oxygen or other reagents/consumables must be identified and quantified; recycling schemes for reagents to minimize consumables should be evaluated.

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. Hardware/concepts need to be designed for compatibility with both 1/6 g flight experiments and ground vacuum experiments.