



## NASA SBIR Select 2014 Phase I Solicitation

### Human Exploration and Operations

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

#### H20.01 Human-Robotic Systems - Manipulation Subsystem and Human-System Interaction

Lead Center: JSC

Participating Center(s): ARC, JPL, KSC

The objective of this topic is to create human-robotic technologies (hardware and software) to improve the exploration of space.

Robots can perform tasks to assist and off-load work from astronauts. Robots may perform this work before, in support of, or after humans.

Ground controllers and astronauts will remotely operate robots using a range of control modes (tele-operation to supervised autonomy), over multiple spatial ranges (shared-space, line-of-sight, in orbit, and interplanetary), and with a range of time-delay and communications bandwidth.

*Manipulation Subsystem* - Proposals are sought that address subsystems that improve handling and maintenance of payloads and assets. Proposals that would directly benefit future ISS robotics (EVA dexterous mobile manipulation and IVA free-flying robot) are highly encouraged. Key technologies of interest include but are not limited to: tactile sensors, human-safe actuation, active structures, dexterous grasping, modular "plug and play" mechanisms for deployment and setup, small/lightweight excavation/drilling devices to enable subsurface access, and novel manipulation methods; as well as, sample handling by both humans and tele-operated robots for storage and in-situ utilization/evaluation.

*Human-System Interaction* - Proposals are sought that address subsystems that enable crew and ground controllers to better operate, monitor and supervise robots. Proposals that would directly benefit future ISS robotics (EVA dexterous mobile manipulation and IVA free-flying robot) are highly encouraged. Key technologies of interest include but are not limited to: robot user interfaces, automated performance monitoring, tactical planning software, ground data system tools, command planning and sequencing, real-time visualization/notification, and software for situational awareness.

Offerors are encouraged to consider all Technology Readiness Level efforts TRL 1-8 when considering proposals for the Phase I and Phase II Deliverables.

Phase I Deliverables may include - Feasibility studies, or they may support an entirely new and innovative potential solution to the Human, Robotics discipline. Demonstrations, taking adapted or targeted innovative solutions from concept through demonstrations in relevant environments and/or use case.

Phase II Deliverables may include but are not limited to - Prototype or Engineering Release products that have evolved from initial concept phases into designs of enough maturity to demonstrate confidence that the product remains viable and feasible for the intended use. The ability to mature concepts along the TRL lifecycle is highly desired and should be emphasized by the offeror.

Reference NASA Office of Chief Technologist Technology Roadmap OCT TA (4.3, 4.4 and 4.7)

<http://www.nasa.gov/offices/oct/home/roadmaps/index.html> [1])

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## **H20.02 International Space Station (ISS) Demonstration and Development of Improved Exploration Technologies**

**Lead Center:** JSC

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

NASA is investing in technologies and techniques geared towards advancing the state of the art of spacecraft systems through the utilization of the ISS as a technology test bed. Desired demonstrations designed to utilize the ISS as a test bed should focus on increasing the Technology Readiness Level (TRL) in the following fields:

- Power Generation and Energy Storage (e.g., regenerative fuel cells).
- Robotics Tele-robotics and Autonomous (RTA) Systems.
- Communication and Navigation (e.g., autonomous rendezvous and docking advancements).
- Human Health, Life Support and Habitation Systems (e.g., closed loop aspects of environmental control and life support systems).
- Environmental Control Systems.
- Radiation Protection and Mitigation.
- Science Instruments, Observatories and Sensor Systems.
- Materials, Structures, Mechanical Systems and Manufacturing.
- Thermal Management Systems.

Successful proposals in these fields are expected to advance the state of the art of spacecraft systems by:

- Increasing capability/operating time including overall operational availability.
- Reducing logistics and maintenance efforts.
- Reducing operational efforts, minimizing crew interaction with both systems and the ground.
- Reducing known spacecraft/spaceflight technical risks and needs.
- Providing information on the long term space environment needed in the development of future spacecraft technologies through model development, simulations or ground testing verified by on-orbit operational data.

For all above technologies, research should be conducted to demonstrate technical feasibility and prototype hardware development during Phase I and show a path toward Phase II hardware and software demonstration and delivering an engineering development unit or software package for NASA testing at the completion of the Phase II contract that could be turned into a proof-of-concept system which can be demonstrated in flight.

Phase I Deliverables - Research to identify and evaluate candidate technologies applications to demonstrate the technical feasibility and show a path towards a hardware/software demonstration. Bench or lab-level demonstrations are desirable. The technology concept at the end of Phase I should be at a TRL of 3-6.

Phase II Deliverables - Emphasis should be placed on developing and demonstrating hardware and/or software prototype that can be demonstrated on orbit (TRL 8), or in some cases under simulated flight conditions. The proposal shall outline a path showing how the technology could be developed into space-worthy systems. The contract should deliver an engineering development unit for functional and environmental testing at the completion of the Phase II contract. The technology at the end of Phase II should be at a TRL of 6-7.

Potential NASA Customers include:

- International Space Station Program ([http://www.nasa.gov/mission\\_pages/station/main/index.html](http://www.nasa.gov/mission_pages/station/main/index.html) [2]).
- Orion Multipurpose Crew Vehicle (<http://www.nasa.gov/exploration/systems/mpcv/index.html> [3]).

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## Human-Robotic Systems - Manipulation Subsystem and Human-System Interaction Topic H20.01

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Sub Topics:

International Space Station (ISS) Demonstration and Development of Improved Exploration Technologies Topic H20.02

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