



## NASA SBIR 2011 Phase I Solicitation

### 03.06 Environmental Control Systems & Technologies for NR & Cubesats

Lead Center: ARC

A significant challenge faced by free-flying spacecraft and shared by ISS-bound experiment packages is the requirement for a controlled (or at least known) environment while the payload is awaiting launch on the launch vehicle or is in transit to the ISS. Due to the retirement of the Space Shuttle, NASA has a need for flight qualified, environmentally conditioned transportation systems compatible with new space launch systems capable of sustaining and extending the life of perishable materials and specimens until experiment packages can be installed and properly interfaced on-board ISS. This solicitation seeks to develop innovative environmental control technologies for the ground and space transportation of nanorack cubes and cubesats.

Cubesat integration timelines frequently call for passively mating to the launch vehicle or deployer system many weeks in advance of launch. The environment that the payload experiences plays a major role on the shelf life of certain materials and specimens within the spacecraft. Technologies capable of monitoring and extending the shelf life of perishable payloads are of interest to NASA as the environment in and around the launch vehicle is not always controlled in a manner favorable to a payload. Technologies can be either integrated directly into the Cubesat or external to the Cubesat.

Two applications for these technologies are sought:

- ISS Nanorack Transportation System.
  - This system will have the ability to maintain temperatures within relevant ranges for biological and/or perishable Nanorack payloads from time of experiment preparation at the payload processing facility until installation into the host facility on ISS. This also includes ground transportation phases of the mission.
  - The Transportation System will also provide a time history of relevant parameters ie temperature, relative humidity, vibration, etc, during the transportation periods up to payload installation on ISS.
  
- Cubesat applications.

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- Cubesat applications involve technologies that may be incorporated into the Cubesat spacecraft itself, or systems that can be used as adjuncts to monitor and control the environment in and around the Cubesat payload/spacecraft. These technologies can be passive and/or active in nature.
  - Cubesat applications will also provide a time history of relevant parameters ie temperature, relative humidity, etc during the dwell time on the pad while awaiting launch.

Innovative approaches to this problem will significantly increase the utility of Nanoracks modules and/or Cubesat spacecraft in that this technology will enable an expanded set of experiment types and mission scenarios. Such a capability may also be extended in support of ground control experiments where on-orbit environments must be duplicated in the lab.

Nanorack information can be found here: <http://nanoracks.com>.

Cubesat information can be found here: <http://cubesat.org/>.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II hardware and software demonstration and delivering a demonstration unit or software package for NASA testing at the completion of the Phase II contract.

#### Phase I Deliverables:

- Midterm Technical Report.
- Final Phase I Technical Report with a feasibility study including: simulations and measurements demonstrating the approach used to develop and test the prototype, constraints on other systems, concept of operations, verification matrix of measurements with pass/fail ranges for each quantity to be verified at the end of Phase II, and the Phase II integration path.
- Proof-of-concept simulation and/or bench top demonstration (TRL 3-4).

#### Phase II Deliverables:

- Midterm Technical Report.
- Final Phase II Technical Report with specifications including: design, development approach, tests to verify the prototype, verification matrix of measurements with pass/fail ranges for each quantity verified, constraints on other systems, and operations guide. Opportunities and plans for potential commercialization should also be included.
- Fully-functional engineering prototype of proposed product (TRL 5-6).

