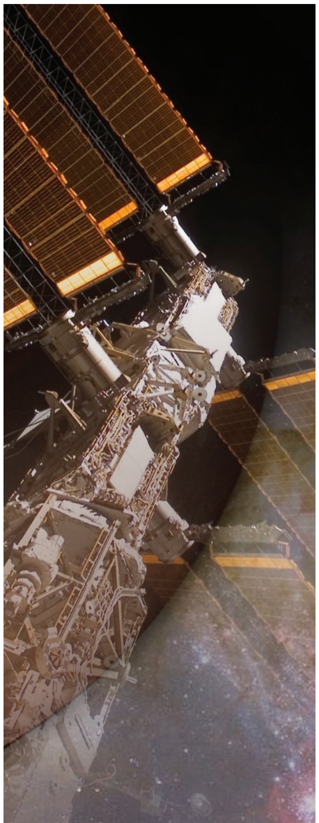

RASC-AL 2012 CALL

Revolutionary Revolutionary Aerospace Systems Concepts - Academic Linkage (RASC-AL) is a student design competition that is sponsored by NASA and managed by the National Institute of Aerospace.

RASC-AL is open to undergraduate and graduate university-level students studying fields with applications to human space exploration (i.e., aerospace, bio-medical, electrical, and mechanical engineering; and life, physical, and computer sciences). RASC-AL projects allow students to incorporate their coursework into real aerospace design concepts and work together in a team environment. Interdisciplinary teams are encouraged.

Challenge themes are announced in August, **NOIs are due November 11, 2011**, and **abstracts are due January 20, 2012**. Upon review of abstracts, selected teams and a faculty advisor are invited to provide a written report and oral presentation at the 2012 RASC-AL Forum, June 11- 13, in Cocoa Beach, FL. Each team receives a stipend to help defray travel expenses to attend the competition, and the winning undergraduate and graduate teams will receive a presentation slot at a major aerospace conference to present their results.

2012 NASA RASC-AL Themes

NEAR-EARTH OBJECT (NEO) FLEXIBLE MISSION ARCHITECTURE DESIGNS

NASA is interested in architecture approaches that provide cost-effective human missions to Near Earth Objects (NEOs) in the 2025 to 2030 timeframe. The number of crew members should be selected to provide cost-effective, safe NEO exploration, while maximizing science return. The specific NEOs (e.g., asteroids) should be selected (a minimum of 3 should be identified) to balance potential threat mitigation, target size, science return, the ability to send a pre-cursor robotic mission, and mission time and cost. The architecture should include launch systems, in-space systems, 'landing' systems, and surface exploration systems, tools and equipment. Innovative robotics system concepts for exploring the surface to enhance the science return, and for gathering samples from at least 10 cm under the surface should be identified. All systems and technologies should be available for initial human missions in 2025 (assuming a suitable number of targets exists), with the ability to add capabilities needed for more challenging NEO missions later. The potential for these same systems being used for cis-Lunar, or other deep-space, human missions should also be examined. Approaches for evolving the architecture to include reusable elements to enable sustainable solar system exploration should be considered.

EARTH-ORBIT DEBRIS MITIGATION AND SATELLITE SERVICING MISSIONS

NASA is interested in approaches that provide cost-effective approaches to orbital debris mitigation and removal from low, medium, and geosynchronous orbits. NASA is also interested in developing the capability for servicing satellites in these orbits with additional propellants or system upgrades. It is anticipated that there is potentially significant synergy between systems developed for these purposes. Recent satellite collisions and destruction have significantly increased the number of objects in Earth-orbit. The objects pose a serious hazard to future spacecraft and human habitats. As the number of objects and collisions increase, a critical number could soon be reached that lead to exponential growth in the number of objects. There is a need to examine the number, size and types of these objects and determine how many and which pose the greatest threat and need to be removed on an annual basis to prevent such a critical number. Approaches for capturing and moving/de-orbiting these objects should be developed. Potential synergy and applicability of these orbital debris mitigation approaches for satellite servicing should also be identified. The life of future satellites could potentially be extended through servicing operations. Systems to be examined for orbital debris removal and satellite servicing include launch systems, space transfer systems, rendezvous and capture systems, and maneuvering/de-orbit systems. All systems and technologies should be available for initial missions in 2015. The approaches are human enabled or a combination of humans and robots, but the benefit of the approach to future human exploration must be discussed.

RASC-AL Revolutionary Aerospace Systems Concepts Academic Linkage

National Institute of Aerospace

RASC-AL

Revolutionary Aerospace Systems Concepts Academic Linkage

HUMAN-FOCUSED MARS MISSION SYSTEMS AND TECHNOLOGIES

NASA is interested in eventual human missions to the Martian surface and its two moons. Current Mars design reference architectures anticipate the use of chemical or nuclear thermal propulsion that require several years to complete, a large number of heavy lift launches and over 500 days on the surface the first time humans visit the planet. The long durations associated with this type of mission pose risks to the crew from deleterious zero-g effects, galactic cosmic radiation, solar proton events, mission related illness or injury and system failure. Innovative technologies and system approaches that improve astronaut health and safety are of great interest. Examples of technologies and systems to address these health-related concerns include: radiation shielding and countermeasures, exercise systems and regimes, medical diagnostic and treatment equipment, advanced telemedicine, hygiene and nutrition approaches, behavioral health, and productivity enhancement. Due to the distance from Earth, time delays and periods of non-communication are anticipated thus medical devices and systems will need to potentially provide decision-making capability and afford the crewmembers autonomy for diagnosis and treatment. Key mission constraints and requirements to be met are: 4-person crew minimum, 30 day minimum Mars surface stay, maximum 2-year total mission, no more than 5 launches of a 130-mT (LEO) payload launch vehicle with a 10-meter-diameter payload shroud and one crew launch. The project shall address all mission aspects and systems, from launch through return as well as surface systems and activities, but may focus on one or more systems. Mission benefits (e.g., improving cost, reliability, or safety) of specific human-focused technologies shall be clearly demonstrated through systems analysis of the entire mission. All systems and technologies should be available for initial missions no earlier than 2035.

LUNAR OUTPOST TO SETTLEMENT ARCHITECTURES

NASA's goal for a lunar outpost is to gain experience that will reduce risk for future human missions to Mars and establish core infrastructure from which economic development and permanent settlement could occur. The associated space transportation and lunar surface system infrastructure should include habitat and research facilities for up to 30 full-time occupants. Although most recent NASA lunar outpost studies have focused on deployment at a polar location, an initial outpost at any location on the lunar can be assumed if there is sufficient rationale, and a demonstrated capability to provide a viable base in that region that could support long-term habitation (beyond a lunar day) and sustained exploration from that site. This topic allows your team to contribute ideas directly to the engineers tasked with developing solutions to these challenges. Some specific examples to be addressed are:

- Utilizing lunar, space, and other planetary resources for infrastructure development, power, and consumables to minimize the logistics supply chain needed from Earth.
- Converting lunar oxygen, hydrogen, and water ice into propellants and transfer to a propellant depot in lunar orbit or at a libration point
- Lunar transportation system(s) for routine access to the settlement and for exploration of remote regions for discovery of new resources.
- Durable lunar settlement designs and settlement layouts, including all required utilities and infrastructure.
- Dramatically improved in-space transportation systems that can significantly reduce cost and improve safety.
- A business plan on how to develop a self-sufficient lunar economy with unique utilization of lunar resources.

Teams will need to show a viable path that leverages and evolves from the currently planned systems/architectures to a sustainable 30 person settlement. All systems and technologies should be available for initial missions in 2025.

Attention should be given to synergistic applications of NASA's initially planned mission or system elements and infrastructure for exploration, innovative combinations of the planned elements, and unique combinations of the planned elements with new innovative capabilities and/or technologies to support the robotic and crewed exploration of the solar system. Scenarios should address novel and robust applications, with an objective of NASA sustaining a permanent and exciting space exploration program.

Key evaluation criteria elements that each RASC-AL project should address are:

- Scientific evaluation and rationale of mission destinations for the development of an exciting and sustainable space exploration program;
- Synergistic application of innovative capabilities and/or new technologies for evolutionary architecture development to enable future missions, reduce cost, or improve safety;
- Key technologies, including technology readiness levels (TRLs), as well as the systems engineering and architectural trades that guide the recommended approach;
- Reliability and human safety consideration in trading various architecture options;
- Realistic assessment of project plan and execution of that plan, including inclusion of a project schedule and test plan, as well as development and realistic annual operating costs