RASC-AL

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.

NOIs are due **November 9, 2012**, and abstracts are due **January 19, 2013**. Upon review of abstracts, selected teams and their faculty advisor will be invited to provide a written report and oral presentation at the **2013 RASC-AL Forum, June 4-6** in Cocoa Beach, FL. Each team will receive a stipend to help defray travel expenses to attend the competition, and two top placing teams will receive a presentation slot at a major aerospace conference to present their concepts.

New for 2013!

Teams can choose to participate in **RASC-AL** in one of two ways:

1. By developing a complete, integrated, end-to-end architecture addressing one of the three themes below (the traditional option); OR
2. By performing a thorough system design of a supporting element such as a mobility system, habitat or lander (the advanced concept option).*

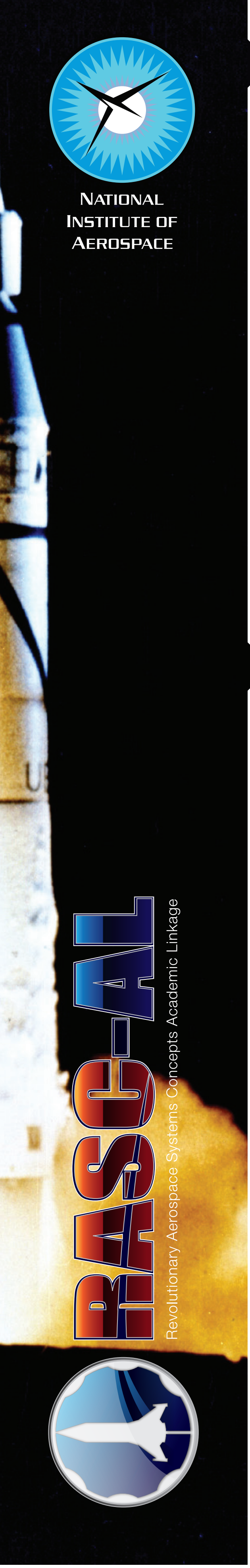
2013 NASA RASC-AL Themes

NEAR EARTH ASTEROID (NEA) FLEXIBLE MISSION ARCHITECTURE DESIGNS

NASA is interested in architecture approaches that provide cost-effective human missions to Near Earth Asteroids (NEAs) in the 2025 to 2035 timeframe. The start of the mission must be launched during this timeframe, but the mission could finish a few years after. The number of crew members should be selected to provide cost-effective, safe NEA exploration, while maximizing science return. A target NEA should be selected 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, and surface exploration systems, tools and equipment. Leveraging the SLS must be considered in the mission analysis, along with justification for using a different launch system if it is determined that the SLS is not the best option. 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. Key technologies, including technology readiness levels (TRLs), should be identified, as well as the systems engineering and architectural trades that guide the recommended approach. Reliability and human safety should be considered in trading various architecture options. Consideration should also be given to how the project would be planned and executed, with the inclusion and of a project schedule, test and development plan, and realistic annual operating costs (i.e., budget).

*Advanced Concept Option

As an alternative to developing a complete end-to-end architecture, a thorough system design of a supporting element such as a mobility system, habitat or lander can be performed. Teams must demonstrate how the supporting element meets the design constraints of one of the three architectures (i.e., themes), and they also must show how the investment in that particular supporting element could be leveraged to be used in the two other architecture scenarios (themes) as well. This approach represents a method for maximizing robustness for mission destinations while minimizing overall investment requirements. As with the integrated mission architectures, key technologies [including technology readiness levels (TRLs)] should be identified, as well as the systems engineering trades that guide the recommended approach. Reliability and human safety should be considered in trading various system options. Consideration should also be given to how the project would be planned and executed, with the inclusion of a project schedule, test and development plan, and production unit costs (i.e., budget).



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 crew members 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 cargo launches of a 130-mT (LEO) payload launch vehicle with a 10-meter-diameter payload shroud
  - Leveraging the SLS must be considered in the mission analysis, along with justification for using a different launch system if it is determined that the SLS is not the best option.
- one crew launch

The project must 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 in 2045. Key technologies, including technology readiness levels (TRLs), should be identified, as well as the systems engineering and architectural trades that guide the recommended approach. Reliability and human safety should be considered in trading various architecture options. Consideration should also be given to how the project would be planned and executed, with the inclusion of a project schedule, test and development plan, and realistic annual operating costs (i.e., budget).

HUMAN LUNAR ACCESS AND INITIAL EXPLORATION

Exploration of the lunar surface and testing of advanced surface exploration capabilities beyond what was accomplished in Apollo will be required before sending humans to the surface of Mars or contemplating lunar settlement. Recent work that NASA has completed working with its international partners included a lunar campaign that featured mobile surface assets that would be relocated in the lunar polar regions robotically between crew visits (Global Point of Departure, GPOD, architecture). This GPOD architecture required a heavy lift launch vehicle much bigger than the currently planned NASA Space Launch System (SLS). The challenge is to develop an architecture that utilizes two 105t class SLS launch vehicles, the NASA Orion multi-purpose crew vehicle and a reusable (partially or fully) low lunar orbit based lander for each crewed mission to the lunar surface and back to Earth. Surface assets that enable the crew to perform exploration can be pre-deployed on separate direct-to-the lunar-surface cargo flights, as well as any orbital assets that are to be re-used each mission.

Key mission constraints and requirements to be met are:

- Crew of 4 to the moon, at least two to the lunar surface
- Lunar surface mission of no longer than 28 days
- Missions to polar regions (sunlit operations only)
- Pressurized mobility for habitation and exploration

The project must 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 in 2025. Key technologies, including technology readiness levels (TRLs), should be identified, as well as the systems engineering and architectural trades that guide the recommended approach. Reliability and human safety should be considered in trading various architecture options. Consideration should also be given to how the project would be planned and executed, with the inclusion of a project schedule, test and development plan, and realistic annual operating costs (i.e., budget).

For all RASC-AL Projects, attention should be given to the following:

- synergistic applications of NASA's planned current missions,
- system elements and infrastructure for human space exploration,
- innovative combinations of the planned elements, and/or
- unique combinations of the planned elements with new innovative capabilities/technologies to support crewed and robotic 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 elements that each RASC-AL project will be evaluated on include:

- 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.