NASA Advisory Council Recommendation

Asteroid Redirect Mission
2015-01-01 (Council-01)

Recommendation:
The Asteroid Redirect Mission (ARM) has two objectives that are particularly important contributors to Humans to Mars (H2M): Large scale solar electric propulsion (SEP) and maneuvering in a low gravity environment in deep space. As work on ARM goes forward and costing is completed, focus on a mission architecture that will preserve these two key H2M objectives if the redirection of an asteroid must be descoped.

Major Reasons for Proposing the Recommendation:
The specific ARM objective of capturing part or all of a small asteroid contributes little to the long-term goal of H2M, contributes only peripherally to planetary defense, and may add a great deal of cost, resulting in exceeding the suggested $1.25B budget cap.

Consequences of No Action on the Proposed Recommendation:
There is a risk that meeting a full set of requirements that includes capturing an asteroid will cause the ARM cost cap to be exceeded, resulting in either a) the cancellation of the entire project, including the very important H2M objectives, or b) the budgetary "goalposts" moving and budget overruns that will threaten other programs.

NASA Response:
NASA has no plans to descope the redirection of an asteroid from the Asteroid Redirect Mission, but NASA concurs that it is important to prioritize and preserve important contributors to Humans to Mars in the architecture for the Asteroid Redirect Robotic Mission. As the NAC is aware, the Agency's highest priority objective for ARM is to conduct a human exploration mission to an asteroid in the mid-2020's, providing systems and operational experience required for human exploration of Mars. The ARM robotic concept architecture includes advanced high-power, long-life SEP and maneuvering in a low gravity environment in deep space. Capture of a multi-ton asteroidal mass and emplacement into a stable orbit in cis-lunar space enables the complex human mission operations within a few days return time to Earth that were envisioned, and described to the NAC, as beginning to move from 'Earth reliant' and toward 'Earth independent' as articulated in NASA's human exploration strategy.

NASA understands the NAC's concern regarding cost risk in the robotic mission. Our approach in formulating the ARM includes leveraging on-going activities, each important in their own right, in an integrated technology demonstration. The early establishment of a succinct set of requirements, early understanding of technical and programmatic risks and associated mitigation/acceptance strategy, a cost cap coupled with a lean implementation approach designed to control cost risk that is led by an experienced project team will enable project development within clear constraints. The spacecraft and mission is architected in a modular way that allows for descopes in the capture system and capture mission to be implemented without risk to the SEP technology demonstration or the crewed mission phase. The current estimate for the capture system is about 12-20% of the total

development cost including reserves. The total mission development is still expected to be within the $1.25B level (not including launch vehicle) previously stated.

NASA believes this programmatic approach will result in a more affordable development cost and that the use of advanced high-power, long-life, high throughput SEP technologies, emerging autonomous navigation, proximity operations, and rendezvous controls and systems, astronaut extravehicular activity systems, and docking standards will advance our deep space exploration capabilities.

There exist uncertainties in our knowledge of characteristics of candidate target asteroids for ARM, which vary across the pool of candidates. NASA leadership has described choices which may be necessary during mission operations in the case that, upon arriving at the selected target asteroid, redirection cannot be accomplished. These should be treated as mission operations contingencies and would result in a more limited crewed mission, but would still preserve the solar electric power and deep space maneuvering the NAC has identified as important contributions to future Mars missions.