NASA Advisory Council Recommendation

Further Development of the Human Exploration Architecture
2015-04-01 (Council-01)

Recommendation:
The Council was very pleased to see the new information that was provided by NASA at this meeting about the Human Exploration architecture. Especially noteworthy were a one-year crewed "shake-down cruise" in cis-lunar space before the end of the 2020s, and the development of a deep space habitat capable of supporting that activity.

In preparation for the 2017 transition of Administrations, the Council recommends that NASA further develop their plan for future Human Exploration, such that it:

(1) Provides a consistent vision across all elements of the program;
(2) Allows selection of technology investments on a timely basis;
(3) Enhances advocacy and continuity of support that transcends Administrations; and
(4) Provides the ability to respond to changes in the external environment (e.g., funding changes or technology breakthroughs).

The level of detail in the plan need only be sufficient to accomplish the four items listed above.

Major Reasons for Proposing the Recommendation:
For the purpose of expanding human presence to the surface of Mars, it is important to define a baseline architecture and plan that encompass the entire Human Exploration program.

Consequences of No Action on the Proposed Recommendation:
Possible impairment of the incoming Administration's ability to propose a NASA budget that will adequately support NASA's Human Exploration plans, especially for important near-term technology investment.

NASA Response:
NASA concurs and is already further developing an integrated human and robotic exploration strategy leading to the human exploration of Mars in the 2030s. NASA's exploration strategy, progress to date, and forward plans are articulated in the recently released "NASA's Journey to Mars – Pioneering Next Steps in Space Exploration." While the capabilities required for a human mission to Mars have been understood in broad terms for some time, the optimal selection of propulsion systems, habitation elements, and transportation methodologies assembled in a total space exploration architecture is the subject of on-going study and implementation. The specific implementation steps and investments, partner approaches, and technical pathways to Mars are varied, and the architecture tradeoffs are complex; thus our plans need to allow for some resiliency for scientific and technology breakthroughs across this multi-decadal effort.

NASA's exploration strategy is to move from today's Earth-reliant posture through the proving

ground of cislunar space to an Earth-independent capability needed to extend human presence into the solar system and to the surface of Mars. This begins with research on the International Space Station (ISS), including the one-year crew increment that completes in March 2016. It continues with crewed Space Launch System (SLS) and Orion missions in cislunar space, including the rendezvous with the redirected asteroid from the Asteroid Redirect Mission (ARM). NASA has defined Exploration Mission-1 (EM-1) mission objectives and is defining mission objectives of EM-2 (first crewed mission of Orion) and EM-3, including systems test and demonstration, and risk reduction for the ARM crewed mission and future mission requirements. For example, SLS evolution from an initial 70 metric ton (to low-Earth orbit or LEO) capability to a 105 metric ton and finally a 130 metric ton capability is tied to mission requirements. Mission options under study which follow ARM include further use of the advanced solar electric propulsion bus used for ARM; addition of deep-space habitation systems; additional potential return missions to the asteroid boulder for expanded science and/or resource utilization; and participation in commercial and/or international missions in the lunar vicinity. These missions will be informed by potential partnering opportunities; the ability to leverage technology developments; the results of architecture tradeoffs; the ability to leverage possible in-situ resources as well as learning about the human ability to live and work longer in deep space (including lessons learned from the ISS).

The series of missions NASA is planning in the "proving ground" of cislunar space will follow a sustainable approach to developing the capabilities required to get humans to Mars. This Proving Ground phase will culminate in a one-year crewed mission in cislunar space that will establish the deep space habitation and other systems required for initation of crewed missions to Mars.

The Agency is tightly coupling the planning of its science and technology portfolios with this strategy including the new capabilities in deep space for habitation, in-space transportation, and joint science/exploration/technology missions to Mars. This coupling will both aid transitions across administrations by broadening stakeholder support as well as leverage Agency resources toward achieving future exploration goals. One such example is the Mars 2020 rover, which will conduct unprecedented exploration technology investigations to help plan for future human missions in addition to its scientific investigations in fulfillment of National Research Council Planetary Science Decadal Survey objectives.

As NASA continues the detailed architecture planning, the Agency will formulate details of future goals, missions, and hardware, and this analysis will be updated in future NASA Advisory Council briefings in 2016.