

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Launch Vehicles in Service or in Development (1)

Author: Mr. Don Sauvageau  
Orbital ATK, United States

Mr. Josh Hopkins  
Lockheed Martin Corporation, United States

## SLS-ORION MISSIONS LEADING TO HUMANS ON MARS

**Abstract**

The exploration goal of the international space community has long been a human mission to Mars. To achieve this goal, NASA is developing the Orion crew capsule and Space Launch System (SLS) as key elements in the eventual architecture for sending humans to Mars. In addition to those assets, other technologies and hardware elements must be developed, like habitats, in-space propulsion, Mars landers and ascent stages. The industry team of Boeing, Lockheed Martin, Aerojet Rocketdyne and Orbital ATK have been working with NASA to develop technical approaches to Mars exploration and a sequence of missions in the 2020s which make incremental progress towards Mars. Defining and prioritizing the technology and hardware needed is important to achieving the goal of landing humans on Mars. We have chosen to prioritize hardware development into three phases: Earth Gravity Well, In-Space Elements, and Mars Gravity Well. The next elements that need to be developed are deep space transit habitats and solar electric propulsion (SEP) tugs, which enable astronauts to live for long periods in space and move between the Earth-Moon system and Mars. We propose that habitation should be developed and tested in the early 2020s by a series of missions to a crew-tended outpost orbiting near the Moon. As such, this paper will concentrate on near term missions that develop and mature concepts for habitats and in-space propulsion that will enable the eventual Mars mission. This paper will discuss near term missions that leverage the Orion and SLS already in development and also mature habitat and SEP concepts. A unique feature that has been developed to enable exciting near term missions is to co-manifest payloads in conjunction with the Orion spacecraft on SLS launches. Doing so provides new flexibility in achieving human exploration, operations, and science objectives on any given mission. This will allow a more efficient utilization of SLS capability and allow the flexibility of performing hardware development, human exploration, and science on each mission. Utilizing this co-manifest capability, the industry team has identified a number of potential near term missions that will mature the near term elements needed for eventual Mars mission, develop mission operations techniques necessary for future Mars mission, refine life support systems, and conduct interesting science. Taking advantage of this SLS co-manifesting capability, this paper will discuss key aspects of the missions that could be conducted over the next decade to place humans on the path to Mars.