

HUMAN SPACEFLIGHT SYMPOSIUM (B3)  
Utilization & Exploitation of Human Spaceflight Systems (3)

Author: Mr. Scott Norris  
Lockheed Martin Space Systems Company, United States

ORION EFT-1 FLIGHT TEST RESULTS AND EM-1 AND EM-2 STATUS

**Abstract**

Orion, the Multi-Purpose Crew Vehicle, is a key piece of the NASA human exploration architecture for beyond earth orbit (BEO). Lockheed Martin was awarded the contracts for the design, development, test, and production for Orion up through the Exploration Mission 2 (EM-2) in 2021. 2014 was a landmark year for Orion and NASA's human spaceflight program. For the past few years, the Orion team has been focused on Exploration Flight Test 1 (EFT-1). EFT-1 completed a nearly flawless mission on December 5, 2014. EFT-1 was launched by a ULA Delta IV Heavy launch vehicle. The mission included one orbit in low earth orbit (LEO) followed by an elliptical orbit with an altitude of 5800 km. This is the highest altitude achieved by a human-capable spacecraft since Apollo 17. This elliptical orbit set up the conditions for re-entry at 80

The flight test objectives for EFT-1 focused on successfully executing the mission, including ground systems integration, critical separation events, thermal protection system performance for the high energy return, and the descent, landing, and recovery sequence. This paper will discuss the results of the post-flight analysis.

The next two flight tests for the Orion program will be Exploration Mission 1 (EM-1) and EM-2. Work on these missions is well underway, with the critical design review on schedule for the fall of 2015. EM-1 will be approximately a 25 day uncrewed mission to a Distant Retrograde Orbit around the moon, in preparation for the Asteroid Retrieval Mission. EM-2 will be the first Orion flight with crew, also to orbit the moon. A successful Delta Preliminary Design Review (PDR) was held in the summer of 2014, reviewing all aspects of the EM-1/2 system design, with a focus on those items which changed since the original PDR in 2009. This paper will discuss those trades, including the mass reduction effort, the change to manufacturing methods for the heatshield, updates to the avionics architecture to optimize fault tolerance, and the changes in the mission architecture due to the European Service Module international partnership.