

Asteroid Redirect Crewed Mission Space Suit and EVA System Maturation

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The Asteroid Redirect Crewed Mission (ARCM) requires a Launch/Entry/Abort (LEA) suit capability and short duration Extra Vehicular Activity (EVA) capability from the Orion spacecraft. For this mission, the pressure garment that was selected, for both functions, is the Modified Advanced Crew Escape Suit (MACES) with EVA enhancements and the life support option that was selected is the Exploration Portable Life Support System (PLSS). The proposed architecture was found to meet the mission constraints, but much more work is required to determine the details of the required suit upgrades, the integration with the PLSS, and the rest of the tools and equipment required to accomplish the mission. This work has continued over the last year to better define the operations and hardware maturation of these systems. EVA simulations have been completed in the NBL and interfacing options have been prototyped and analyzed with testing planned for late 2014.

For NBL EVA simulations, in 2013, components were procured to allow in-house build up for four new suits with mobility enhancements built into the arms. Boots outfitted with clips that fit into foot restraints have also been added to the suit and analyzed for possible loads. Major suit objectives accomplished this year in testing include: evaluation of mobility enhancements, ingress/egress of foot restraint, use of foot restraint for worksite stability, ingress/egress of Orion hatch with PLSS mockup, and testing with two crew members in the water at one time to evaluate the crew's ability to help one another. Major tool objectives accomplished this year include using various other methods for worksite stability, testing new methods for asteroid geologic sampling and improving the fidelity of the mockups and crew equipment. These tests were completed on a medium fidelity capsule mockup, asteroid vehicle mockup, and asteroid mockups that were more accurate for an asteroid type EVA than previous tests.

Another focus was the design and fabrication of the interface between the MACES and the PLSS. The MACES was not designed to interface with a PLSS, hence an interface kit must accommodate the unique design qualities of the MACES and provide the necessary life support function connections to the PLSS. A prototype interface kit for MACES to PLSS has been designed and fabricated. Unmanned and manned testing of the interface will show the usability of the kit while wearing a MACES. The testing shows viability of the kit approach as well as the operations concept. The design will be vetted through suit and PLSS experts and, with the findings from the testing, the best path forward will be determined.

As the Asteroid Redirect Mission matures, the suit/life support portion of the mission will mature along with it and EVA Tools & Equipment can be iterated to accommodate the overall mission objectives and compromises inherent in EVA Suit optimization. The goal of the EVA architecture for ARCM is to continue to build on the previously developed technologies and lessons learned, and accomplish the ARCM EVAs while providing a stepping stone to future missions and destinations.