NASA's Space Launch System: Development and Progress

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Abstract

NASA is embarked on a new era of space exploration that will lead to new capabilities, new destinations, and new discoveries by both human and robotic explorers. Today, the International Space Station (ISS), supported by NASA's commercial partners, and robotic probes, are yielding knowledge that will help make this exploration possible. NASA is developing both the Orion crew vehicle and the Space Launch System (SLS) that will carry out a series of increasingly challenging missions that will eventually lead to human exploration of Mars. This paper will discuss the development and progress on the SLS. The SLS architecture was designed to be safe, affordable, and sustainable. The current configuration is the result of literally thousands of trade studies involving cost, performance, mission requirements, and other metrics. The initial configuration of SLS, designated Block 1, will launch a minimum of 70 metric tons (t) into low Earth orbit – significantly greater capability than any current launch vehicle. It is designed to evolve to a capability of 130 t through the use of upgraded main engines, advanced boosters, and a new upper stage. With more payload mass and volume capability than any rocket in history, SLS offers mission planners larger payloads, faster trip times, simpler design, shorter design cycles, and greater opportunity for mission success. Since the program was officially created in fall 2011, it has made significant progress toward first launch readiness of the Block 1 vehicle in 2018. Every major element of SLS continued to make significant progress in 2015. The Boosters element fired Qualification Motor 1 (QM-1) in March 2015, to test the 5-segment motor, including new insulation, joint, and propellant grain designs. The Stages element marked the completion of more than 70 major components of test article and flight core stage tanks. The Liquid Engines element conducted seven test firings of an RS-25 engine under SLS conditions. The Spacecraft/Payload Integration and Evolution element marked completion of the upper stage test article. Major work continues in 2016 as the program continues both flight and development RS-25 engine testing, begins welding test article and flight core stage tanks, completes stage adapter manufacturing, and test fires the second booster qualification motor. This paper will discuss the program's key accomplishments to date and the challenging work ahead for what will be the world's most capable launch vehicle.