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Space Launch System Spacecraft and Payload Elements: Making Progress Toward First Launch

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Significant and substantial progress continues to be accomplished in the design, development, and testing of the Space Launch System (SLS), the most powerful human-rated launch vehicle the United States has ever undertaken. Designed to support human missions into deep space, SLS is one of three programs being managed by the National Aeronautics and Space Administration's (NASA's) Exploration Systems Development directorate. The Orion spacecraft program is developing a new crew vehicle that will support human missions beyond low Earth orbit, and the Ground Systems Development and Operations program is transforming Kennedy Space Center into next-generation spaceport capable of supporting not only SLS but also multiple commercial users. Together, these systems will support human exploration missions into the proving ground of cislunar space and ultimately to Mars. SLS will deliver a near-term heavy-lift capability for the nation with its 70 metric ton (t) Block 1 configuration, and will then evolve to an ultimate capability of 130 t. The SLS program marked a major milestone with the successful completion of the Critical Design Review in which detailed designs were reviewed and subsequently approved for proceeding with full-scale production. This marks the first time an exploration class vehicle has passed that major milestone since the Saturn V vehicle launched astronauts in the 1960s during the Apollo program. Each element of the vehicle now has flight hardware in production in support of the initial flight of the SLS -- Exploration Mission-1 (EM-1), an un-crewed mission to orbit the moon and return. Encompassing hardware qualification, structural testing to validate hardware compliance and analytical modeling, progress in on track to meet the initial targeted launch date in 2018. In Utah and Mississippi, booster and engine testing are verifying upgrades made to proven shuttle hardware. At Michoud Assembly Facility in Louisiana, the world's largest spacecraft welding tool is producing tanks for the SLS core stage. This paper will particularly focus on work taking place at Marshall Space Flight Center (MSFC) and United Launch Alliance in Alabama, where upper stage and adapter elements of the vehicle are being constructed and tested. Providing the Orion crew capsule/launch vehicle interface and in-space propulsion via a cryogenic upper stage, the Spacecraft/Payload Integration and Evolution (SPIE) Element serves a key role in achieving SLS goals and objectives. The SPIE element marked a major milestone in 2014 with the first flight of original SLS hardware, the Orion Stage Adapter (OSA) which was used on Exploration Flight Test-1 with a design that will be used again on EM-1. Construction is already underway on the EM-1 Interim Cryogenic Propulsion Stage (ICPS), an in-space stage derived from the Delta Cryogenic Second Stage. Manufacture of the Orion Stage Adapter and the Launch Vehicle Stage Adapter is set to

begin at the Friction Stir Facility located at MSFC while structural test articles are either completed (OSA) or nearing completion (Launch Vehicle Stage Adapter). An overview is provided of the launch vehicle capabilities, with a specific focus on SPIE Element qualification/testing progress, as well as efforts to provide access to deep space regions currently not available to the science community through a secondary payload capability utilizing CubeSat-class satellites.