Large Payload Ground Transportation and Test Considerations

Michelle A. Rucker[1]
National Aeronautics and Space Administration, Houston, Texas 77058

Abstract

During test and verification planning for the Altair lunar lander project, a National Aeronautics and Space Administration (NASA) study team identified several ground transportation and test issues related to the large payload diameter. Although the entire Constellation Program—including Altair—has since been canceled, issues identified by the Altair project serve as important lessons learned for payloads greater than 7 m diameter being considered for NASA's new Space Launch System (SLS). A transportation feasibility study found that Altair's 8.97 m diameter Descent Module would not fit inside available aircraft. Although the Ascent Module cabin was only 2.35 m diameter, the long reaction control system booms extended nearly to the Descent Module diameter, making it equally unsuitable for air transportation without removing the booms and invalidating assembly workmanship screens or acceptance testing that had already been performed. Ground transportation of very large payloads over extended distances is not generally permitted by most states, so overland transportation alone would not be an option. Limited ground transportation to the nearest waterway may be possible, but water transportation could take as long as 66 days per production unit, depending on point of origin and acceptance test facility; transportation from the western United States would require transit through the Panama Canal to access the Kennedy Space Center launch site. Large payloads also pose acceptance test and ground processing challenges. Although propulsion, mechanical vibration, and reverberant acoustic test facilities at NASA's Plum Brook Station have been designed to accommodate large spacecraft, special handling and test work-arounds may be necessary, which could increase cost, schedule, and technical risk. Once at the launch site, there are no facilities currently capable of accommodating the combination of large payload size and hazardous processing such as hypergolic fuels, pyrotechnic devices, and high pressure gasses. Ironically, the limiting factor to a national heavy lift strategy may not be the rocket technology needed to throw a heavy payload, but rather the terrestrial infrastructure—roads, bridges, airframes, and buildings—necessary to transport, acceptance test, and process large spacecraft. Failure to carefully consider where and how large spacecraft are manufactured, tested, and launched could result in unforeseen cost to modify existing (or develop new) infrastructure, or incur additional risk due to increased handling operations or eliminating key verifications.

[1] Engineer, Exploration Mission Planning Office/Mail Stop XM.