SSME to RS-25: Challenges of Adapting a Heritage Engine to a New Vehicle Architecture

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Abstract

Following the cancellation of the Constellation program and retirement of the Space Shuttle, NASA initiated the Space Launch System (SLS) program to provide next-generation heavy lift cargo and crew access to space. A key constituent of the SLS architecture is the RS-25 engine, also known as the Space Shuttle Main Engine (SSME). The RS-25 was selected to serve as the main propulsion system for the SLS core stage in conjunction with the solid rocket boosters. This selection was largely based on the maturity and extensive experience gained through 135 missions, 3000+ ground tests, and over a million seconds total accumulated hot-fire time. In addition, there were also over a dozen functional flight assets remaining from the Space Shuttle program that could be leveraged to support the first four flights.

However, while the RS-25 is a highly mature system, simply unbolting it from the Space Shuttle boat-tail and installing it on the new SLS vehicle is not a "plug-and-play" operation. In addition to numerous technical integration details involving changes to significant areas such as the environments, interface conditions, technical performance requirements, operational constraints and so on, there were other challenges to be overcome in the area of replacing the obsolete engine control system (ECS). While the magnitude of accomplishing this effort was less than that needed to develop and field a new clean-sheet engine system, the path to the first flight of SLS has not been without unexpected challenges.