

Commercial partners are expanding access to space

BY ERICA RODGERS

The **Space Systems Technical Committee** fosters the development, application and operation of space systems and addresses emerging issues in the area.

A major theme in space systems during 2016 was the expanded presence of commercial partners to enable crew and cargo capabilities, as well as flight test opportunities. Several of these partners offer reusable systems as the future operating model of access to space.

Throughout the year, NASA sent science and research experiments and cargo to the International Space Station via the Commercial Cargo Program. Orbital ATK launched a **Cygnus** spacecraft using an Atlas 5 rocket to the ISS on separate

► Blue Origin's New Shepard booster

executes a controlled vertical landing at 4.2 mph in January after both the capsule and booster reached an altitude of over 333,000 feet.



Blue Origin

cargo missions in December 2015 and March, and launched its sixth cargo resupply mission from the Wallops Flight Facility, Maryland, in October using an Antares rocket. The Cygnus spacecraft housed a large-scale flame spread and material flammability experiment conducted during re-entry on the fifth cargo resupply mission.

SpaceX launched two cargo missions, its eighth and ninth, in April and July using the Dragon spacecraft and **Falcon 9 rocket** from the Cape Canaveral Air Force Station in Florida. SpaceX for the first time succeeded at landing the first stage of the Falcon 9 on a droneship in the Atlantic Ocean following the April 8 launch of a Dragon cargo spacecraft to the ISS.

Sierra Nevada Corp. continues to work toward certification of its **Dream Chaser** spacecraft for cargo transfer to and from the ISS. The company passed the second Integration Certification Milestone in July in preparation for a minimum of six cargo delivery missions between 2019 and 2024.

Partners of the **Commercial Crew Program**

continue to prepare to ferry crew to and from the ISS. SpaceX's Crew Dragon spacecraft is now planned for use in two operational missions, as is Boeing's CST-100 Starliner spacecraft.

NASA's commercial partners prepare to expand the number of available technology maturation testing platforms through NASA's Flight Opportunities Program. In June, Blue Origin was selected to provide suborbital flights aboard its New Shepard rocket and capsule to test technologies in micro-gravity. Blue Origin demonstrated its reusable systems through a booster vertical landing, followed by re-use of the hardware for successive flights.

Virgin Galactic, another commercial partner, unveiled the **Virgin Spaceship Unity** in February to replace the original SpaceShipTwo that broke apart during a test flight in 2014. The Unity was subsequently awarded an FAA operator license for commercial operations.

Partners in the Commercial Crew and Cargo Program will continue to transfer cargo to and from the ISS during 2017, as well as prepare for planned crew transfers in 2018.

Other 2016 highlights included:

- The joint U.S.-European Earth observing satellite, **Jason-3**, launched in January aboard SpaceX's Falcon 9 rocket from Vandenberg Air Force Base, California. This is the fourth in a series of satellite missions that measure the height of the ocean surface. Jason-3 uses a radar altimeter to measure sea-level variations over the global ocean with very high accuracy.
- Early this year, NASA successfully completed a comprehensive review of plans to modernize the ground support systems at Kennedy Space Center, Florida, in preparation for the first Space Launch System/Orion launch in 2018. In May, the **Orion pressure vessel** passed a pressurization test at Kennedy; in June, the final qualification test of the SLS solid rocket booster took place at Orbital ATK's Promontory Propulsion Systems facility in Utah, and in July, the SLS RS-25 rocket engine underwent a successful developmental test at NASA Stennis Space Center, Mississippi.

- After a five-year journey, NASA's **Juno** spacecraft entered Jupiter's orbit on July 4 following a 35-minute Leros 1-pound main engine burn. Juno's suite of nine instruments will improve our understanding of the origin and evolution of Jupiter, and thus our understanding of the solar system's beginning. The primary science mission began in October when another engine burn moved the spacecraft into a 14-day orbit designed to cover the entire planet. ★