National Aeronautics and Space Administration

SpaceX Demonstration Mission

MISSION OVERVIEW

For the first time in history, a private corporation is set to prove it can deliver cargo to the International Space Station. At the Cape Canaveral Air Force Station, Fla., a Falcon 9 rocket belonging to Space Exploration Technologies (SpaceX), is being prepared to place its Dragon spacecraft into orbit on a test mission to the orbital outpost.

Working for the past six years under NASA's Commercial Orbital Transportation Services program (COTS), both SpaceX and Orbital Sciences Corp. have been pursuing independent efforts to design, test and fly two brand new cargo vehicles. These will provide the United States with safe, reliable and efficient cargo delivery services to the orbiting complex NASA built with its international partners.

The first COTS demonstration flight that SpaceX completed was in December 2010, where it proved that it could launch, orbit and recover its Dragon spacecraft. Prior to that, the maiden flight of the Falcon 9 demonstrated it could launch a Dragon capsule simulator atop a Falcon 9 rocket. This upcoming mission will prove that Dragon can rendezvous and berth with the International Space Station.

After launching from the Cape Canaveral Air Force Station, Dragon will begin its journey to the space station. Just under 10 minutes after launch, Dragon will reach its preliminary orbit, deploy its solar arrays and begin a carefully choreographed series of engine firings to reach the station. During this part of the flight, Dragon will demonstrate the first set of tests as part of its COTS milestone requirements. The spacecraft will perform a test of its Absolute GPS (AGPS) system, using global positioning system satellites to determine its location. It also will conduct a free drift demonstration, allowing the spacecraft to float freely with all of its thrusters inhibited. Then Dragon will perform a demonstration of its abort capability, to ensure it could move away from the station if necessary.

On the third day of the flight, Dragon will perform a burn that will bring it to a path 2.5 kilometers (1.5 miles) below the station. During this "fly-under," Dragon will establish UHF communication with the station using its COTS Ultra-high frequency Communication Unit (CUCU). Dragon will perform a test of

its Relative GPS (RGPS) system, which uses the relative positions of the spacecraft to the space station to determine its location. Also, using the crew command panel (CCP) on board the station, the Expedition crew will briefly interact with Dragon, monitoring the fly-under and sending a command to Dragon to turn on its strobe light. This ability for the crew to send commands to Dragon will be important for the next day's activity. Once the fly-under is complete, Dragon will fire its engines to begin a loop out in front, above and then behind the station in a racetrack pattern at a distance between 7-10 kilometers (4-6.2 miles). This will set the spacecraft up for a re-rendezvous with the station the next day.

For its final day of approach to the station, Dragon will perform another engine burn that will bring it 2.5 kilometers (1.5 miles) below the station once again. A go/no-go is performed by the Mission Control Houston team to allow Dragon to perform another set of burns that will bring it to within 1.4 kilometers (0.87 miles) of the station. Another go/no-go will take place from Mission Control Houston, and then Dragon will move from up to 250 meters (820 feet) from the station. The next set of COTS milestone demonstrations will begin, the first of which is Dragon's test of its LIDAR system. This test will confirm that Dragon's position and velocity is accurate by comparing the LIDAR image that Dragon receives against Dragon's thermal imagers. A series of checkout maneuvers will commence. The Dragon flight control team in Hawthorne, Calif., will command the spacecraft to approach the station from its hold position. It will move from 250 meters to 220 meters below the station (720 feet). The crew, using the CCP, will then command Dragon to retreat, and the spacecraft will move back down to the hold point. This test will ensure that Dragon's range to the ISS is accurate, and that the flight control team sees the spacecraft's acceleration and braking perform as expected. It will hold at 250 meters, and once again the Dragon flight team will command it to approach the station. At the 220 meter position, the crew will command the vehicle to hold.

Another go/no-go is performed in Houston, and then Dragon is permitted to enter inside the Keep-Out Sphere (KOS), an imaginary circle drawn 200 meters (656 feet) around the station that prevents the risk of collision with the orbiting complex. Dragon will proceed to a position 30 meters (98 feet) from the station and will automatically hold. Another go/no-go is completed, and then Dragon will proceed to the 10 meter (32 feet) position, which is the capture point. A final go/no-go is performed, and the Mission Control Houston team will notify the crew they are go to capture Dragon.

At that point, Expedition 31 crew member Don Pettit will use the station's robotic arm, which measures 17.6 meters (57.7 feet) long, to reach out and grapple the Dragon spacecraft. Pettit, with the help of fellow crewmember Andre Kuipers, will guide Dragon to the bottom, Earth-facing side of the Harmony node, where it will be attached to the station. If the rendezvous and Dragon testing runs long, Mission

Control could elect to leave Dragon grappled to the station's arm overnight before berthing it the next day.

The crew will open the hatch between the Dragon and the station the following day, after performing an inspection of the air inside Dragon, a standard procedure for any visiting vehicle. The crew will spend about 25 hours over the next couple of weeks unloading the Dragon of the cargo that was flown up to the station. On this test flight, Dragon will transport 460 kilograms (1,014 pounds) of cargo and will return 620 kilograms (1,367 pounds). Because this is a test flight, the cargo being brought to the station is considered non-critical and includes additional food, water and clothing for the station residents. It will supplement what was flown on the European Space Agency's Automated Transfer Vehicle, which docked with the station on March 28.

Dragon will spend about 18 days attached to the space station, at which point the crew will detach it from Harmony, maneuver it out to the 10 meter release point and then will ungrapple the vehicle. Dragon will perform a series of engine burns what will place it on a trajectory to take it away from the vicinity of the station. Mission Control Houston will then confirm that Dragon is on a safe path away from the complex.

Approximately four hours after Dragon leaves the station, it will conduct its deorbit burn, which lasts about seven minutes. It takes about 30 minutes for Dragon to re-enter the Earth's atmosphere and splashdown in the Pacific Ocean, about 450 kilometers (250 miles) off the West Coast of the United States.