NASAfacts

Orion Recovery Operations

The Orion spacecraft's first flight atop the Space Launch System (SLS) rocket will pave the way for future crewed missions to the Moon and on to Mars. During this uncrewed flight, designated Artemis I, the spacecraft will travel thousands of miles beyond the Moon and then back to Earth over the course of about three weeks.

As part of the return trip to Earth, Orion will fly within about 60 miles of the Moon's surface. The spacecraft will execute a precisely timed engine firing of the European-provided Service Module in conjunction with the Moon's gravity to accelerate back toward Earth, where it will enter the atmosphere traveling at 25,000 miles per hour. During re-entry, Orion will slow to 300 mph, then parachutes will deploy to slow the spacecraft to approximately 20 mph before splashing down in the Pacific Ocean about 60 miles off the coast of California.

Recovery Operations

The Landing and Recovery Team, led by Exploration Ground Systems from Kennedy Space Center in Florida, will be responsible for safely recovering the capsule, and crew on future missions, after splashdown and returning them both to land. The interagency landing and recovery team consists of personnel and assets from the U.S. Department of Defense, including Navy amphibious specialists and Air Force weather specialists, and engineers and technicians from Kennedy, Johnson Space Center in Houston, and Lockheed Martin Space Operations. The team will recover Orion and attempt to recover hardware jettisoned during landing, such as the forward bay cover and the three main parachutes.

Before splashdown of the spacecraft, the recovery team will head out to sea in a Navy amphibious ship that has a well deck at the waterline to allow boats to dock with the ship. During a crewed mission, the astronauts can be recovered in either open water or the well deck of the ship depending on sea conditions and other factors on day of landing. During an open water crew egress, the Navy divers will install a stabilization collar around the spacecraft and an inflatable platform, known as the front porch, to assist with stabilizing Orion and helping recover the astronauts.

During Underway Recovery Test-7 (URT-7), U.S. Navy divers approach a test version of the Orion capsule to practice securing it for recovery into the well deck of an amphibious assault ship on Oct. 31, 2018 in the Pacific Ocean. Photo credit: NASA/Kim Shiflett

During crew recovery in the well deck, a crew egress stand will be prepositioned to access and recover the crew after the spacecraft is fully recovered into the well deck.

At the direction of the NASA Recovery Director, Navy divers and other team members in several inflatable boats will be cleared to approach Orion's location. When Orion is ready to be pulled into the well deck, the divers will attach a cable to pull the spacecraft into the ship, called the winch line, and up to four additional tending lines to attach points on the spacecraft. The winch will pull Orion into a specially designed cradle inside the ship's well deck and the other lines will control the lateral motion of the spacecraft. Once Orion is positioned above the cradle assembly, the well deck will be drained and Orion will be secured on the cradle.

Open water personnel will work to recover Orion's forward bay cover and three main parachutes to the port side of the Navy ship, where a crane will lift them onto the ship's main deck. If teams are able to recover the jettisoned cover and parachutes, engineers can inspect the hardware and gather additional performance data. If recovered, the parachutes will be transported to a facility for drying, and then to the supplier for inspection. The spacecraft and other hardware will be transported on the ship from the landing site to a pier at U.S. Naval Base San Diego. After Orion and the other associated hardware are secured in the Recovery Transportation Fixture, a platform nicknamed the Armadillo, they will be transported by truck to Kennedy.

Recovery personnel have practiced procedures and operations in the Neutral Buoyancy Laboratory pool near Johnson Space Center and in the open water off the coast of California during a series of Underway Recovery Tests, using a test version of the Orion spacecraft and other equipment that will be used during recovery operations. These tests help to evaluate and improve recovery procedures and hardware ahead of Orion's flight on Artemis I, and prior to the first crewed mission, Artemis II. Testing also included recovering the spacecraft from Orion's first flight test, Exploration Flight Test-1, when Orion launched atop a Delta IV Heavy rocket on Dec. 5, 2014, from Space Launch Complex 37 at Cape Canaveral Air Force Station in Florida. The two-orbit, four-and-a-half hour mission tested systems critical to crew safety, including key separation events, the heat shield, and the parachute systems before splashing down in the Pacific Ocean about 600 miles off the coast of San Diego, California.

Building on 50 years of experience in spacecraft recovery operations, Exploration Ground Systems is helping the agency prepare for the Artemis program, which will send the first woman and next man to step foot on the Moon, and will lead Orion recovery operations. NASA personnel at Kennedy gained expertise in deploying and leading complex integrated recovery teams at off-site locations throughout the world during the Apollo Program, Launch Services Program rocket launches, and all 135 historic space shuttle launches, working hand in hand with military personnel (both foreign and domestic), developing and coordinating search and rescue efforts, and creating and implementing recovery operations concepts and procedures compatible with the unique spacecraft or payload hazards and requirements.

NASA Recovery Team members watch as a test version of the Orion capsule is pulled into the flooded well deck of the USS John P. Murtha, during Underway Recovery Test-7 (URT-7) on Oct. 30, 2018. URT-7 is one in a series of tests that the Exploration Ground Systems Recovery Team, along with the U.S. Navy and Lockheed Martin, are conducting to verify and validate procedures and hardware that will be used to recover the Orion spacecraft after it splashes down in the Pacific Ocean following deep space exploration missions. Orion will have emergency abort capability, sustain the crew during space travel and provide safe re-entry from deep space return velocities. Photo credit: NASA/Tony

National Aeronautics and Space Administration

John F. Kennedy Space Center
Kennedy Space Center, FL 32899

www.nasa.gov

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