



# Orion Recovery Operations

The Orion spacecraft is NASA's newest exploration vehicle. It is a capsule designed to carry astronauts to destinations never before explored by humans, including an asteroid and eventually Mars. Orion will have emergency abort capability, sustain the crew during space travel and provide safe re-entry from deep space.

Orion launched on its first flight test in early December 2014. The uncrewed spacecraft launched aboard a United Launch Alliance Delta IV Heavy rocket from Cape Canaveral Air Force Station in Florida. It traveled 3,600 miles above Earth and returned at a speed of approximately 20,000 mph. Orion splashed down in the Pacific Ocean, about 600 miles south of San Diego, California. The mission provided engineers with information that will help improve the design of Orion to carry astronauts to deep space and return them home.

## Recovery Operations

Before Orion's splashdown in the Pacific Ocean, helicopters will take off from the U.S. Navy ship's deck and fly out to help locate Orion as it makes its descent toward the ocean.

After Orion's splashdown in the Pacific Ocean, an integrated team of U.S. Navy amphibious specialists, engineers and technicians from NASA's Ground Systems Development and Operations (GSDO) program at the agency's Kennedy Space Center in Florida, Johnson Space Center in Houston, and Lockheed Martin Space Operations, will recover the Orion crew module and attempt to recover the jettisoned hardware, including the forward bay cover and parachutes.

Minutes after Orion splashes down, the crew module uprighting system will inflate to help



The Orion crew module was recovered Dec. 6, 2014, after splashdown in the Pacific Ocean about 600 miles off the coast of San Diego, California. NASA, the U.S. Navy and Lockheed Martin coordinated efforts to recover Orion and secure the spacecraft inside the well deck of the USS Anchorage. After lifting off at 7:05 a.m. EST atop a Delta IV Heavy rocket from Space Launch Complex 37 at Cape Canaveral Air Force Station in Florida, NASA's Orion spacecraft completed a two-orbit, four-and-a-half hour mission to test systems critical to crew safety, including the launch abort system, the heat shield and the parachute system. The Ground Systems Development and Operations Program led the recovery efforts. Photo courtesy of U.S. Navy

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stabilize the spacecraft in case it doesn't land heat shield first in the water.

U.S. Navy divers in rigid hull inflatable boats and smaller Zodiac boats will check for any hazards around Orion. Then they will attach tending lines to five attach points on the crew module and work to tow the vehicle into the ship's well deck. After the crew module is winched into the flooded well deck of the LPD Ship it will be placed on rubber shock absorbers. Water will be drained from the well deck, leaving Orion secure and dry.

Once the ship starts the journey back to shore and reaches calm waters, the crew module then will be placed into its recovery cradle and readied for offloading.

Rigid-hull inflatable boats will be used to secure and reposition Orion's forward bay cover and parachutes to the port side of the Navy ship where a crane will lift them onto the ship's main deck. The crew module and jettisoned hardware will be transported from the landing site to a pier at the U.S. Naval Base San Diego. After they are secured in the Recovery Transportation Fixture, a platform nicknamed the Armadillo, the



U.S. Navy divers in Zodiac boats prepare to recover Orion from the Pacific Ocean and tow her in to the well deck of the USS Anchorage on Dec. 6, 2014. Photo courtesy of U.S. Navy

Orion crew module and hardware will be transported by truck to Kennedy, where they will be prepared for the next mission.

During future crewed exploration missions in Orion propelled by NASA's Space Launch System rocket, the recovery procedures will be adjusted to allow for extraction of the crew members. They will undergo a thorough medical evaluation on the ship.

Several of the unique pieces of Orion recovery hardware were designed and developed by NASA and Lockheed Martin engineers and technicians at Kennedy.

Building on 50 years of experience in spacecraft recovery operations, NASA's GSDO Program at Kennedy

Space Center is helping the agency prepare for future human deep space exploration, and will play a key role in Orion recovery operations.

During NASA's Apollo Program, Launch Services Program rocket launches and all 135 space shuttle launches, Kennedy's expertise included deploying and leading complex integrated teams at off-site locations throughout the world, working hand in hand with military personnel (both foreign and domestic), developing and coordinating search and rescue efforts with the Department of Defense, and implementing a recovery operations concept that is compatible with the unique spacecraft, payload hazards and requirements.

### More online

For more information about the Orion Program, visit:

<http://www.nasa.gov/orion>.

For more information about the GSDO Program, visit:

<http://nasa.gov/groundsystems>.

To view the latest Kennedy Space Center fact sheets, go to <http://go.nasa.gov/11KR0r6>.

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