



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 will launch on its first flight test in early December. The uncrewed spacecraft will launch aboard a United Launch Alliance Delta IV Heavy rocket from Cape Canaveral Air Force Station in Florida. It will travel 3,600 miles above Earth and return a speed of approximately 20,000 mph. Orion will splashdown in the Pacific Ocean, about 600 miles south of San Diego, California. The mission will provide 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 launches on its flight test from Cape Canaveral Air Force Station in Florida, the 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 embark aboard two ships, the U.S. Navy's amphibious ship, the USS Anchorage, and the Navy's salvage ship, the USNS Salvor.

While the team waits for Orion to take flight, it will launch weather balloons from the deck of the ship and monitor sea conditions. Before Orion's splashdown in the Pacific Ocean, helicopters will take off from the ship's deck and fly out



The Orion boilerplate test vehicle floated in the Pacific Ocean near the USS Anchorage on Sept. 15 during Underway Recovery Test 3. U.S. Navy divers and other recovery team members in two Zodiac boats attached tether lines to Orion.

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to help locate Orion as it makes its descent toward the ocean. After Orion's splashdown, the team will recover the crew module and attempt to recover hardware that was jettisoned, including the forward bay cover and parachutes.

Minutes after Orion splashes down, the crew module uprighting system will inflate to help stabilize the spacecraft in case it doesn't land heat shield first in the water.

U.S. Navy divers in Zodiac boats will check for any hazards around Orion. Then they will attach a sea anchor, load-distributing horse collar and tether lines to the crew module and work to guide it to the ship's well deck. The crew module will be winched into the flooded well deck of the USS Anchorage and 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.

The USNS Salvor and rigid-hull inflatable boats will be used to secure and recover Orion's forward bay cover and parachutes. The Salvor's cranes will be used to lift the forward bay cover and parachutes onto the ship's 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 the crew module is secured in the Recovery Transportation Fixture, a platform nicknamed the Armadillo, the Orion crew module and hardware will be transported by truck to Kennedy, where the crew module will be prepared for reuse in Ascent Abort Test-2. Additional hardware may be used for other testing.

The team also is prepared to use an alternative crew module recovery method in case Orion can't be recovered using the USS Anchorage ship's well deck. At sea, a sling would be placed around Orion and the stationary crane on the USNS Salvor would be used to lift the crew module up and onto the deck where it will be secured. In case of very turbulent sea conditions, the USNS Salvor could tow Orion along until calmer



ABOVE: The Orion boilerplate test vehicle is tethered and guided back into the water-filled well deck of the USS Anchorage on Sept. 17 during Underway Recovery Test 3 in the Pacific Ocean. BELOW: An H60-S helicopter takes off from the deck of the USS Anchorage on Sept. 15 during the first day of Orion Underway Recovery Test 3 activities.



seas are reached and it can be recovered.

During future crewed Orion exploration missions propelled by NASA's Space Launch System rocket, the recovery procedures will be adjusted to allow for extraction of the crew members. NASA astronauts will remain inside Orion after splashdown and be removed after the craft is secured inside the well deck of the Navy ship. There, a platform will be moved into place after the water has drained from the deck, allowing the astronauts to climb out. They will undergo a thorough medical evaluation on the ship.

Several of the unique pieces of Orion recovery



NASA and the U.S. Navy practiced lifting the Orion boilerplate test vehicle using the stationary crane on the USNS Salvor, a salvage ship, during an Orion underway recovery test in the Pacific Ocean.



The Orion boilerplate test vehicle was tethered and guided back into the water-filled well deck of the USS Anchorage on Sept. 17 during Underway Recovery Test 3 in the Pacific Ocean.

hardware were designed and developed by NASA and Lockheed Martin engineers and technicians at Kennedy. Lockheed Martin designed the cradle Orion will sit on inside the well deck. It will be used to secure Orion in the recovery ship and move it out of the ship after returning to port.

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.

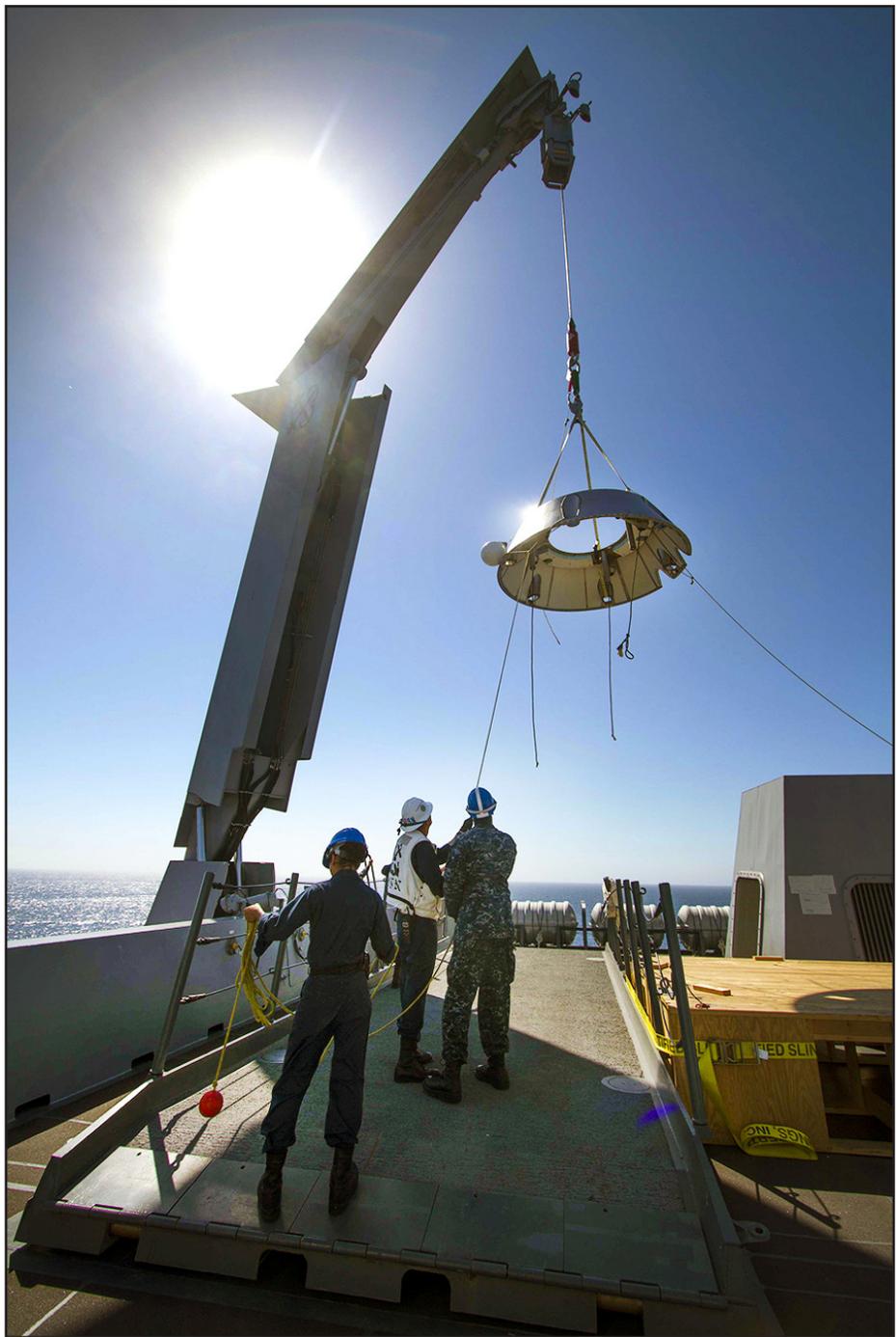
More online

For more information about the Orion Program, visit:

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

For more information about the GSDO Program, visit:

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



A mock-up of the Orion forward bay cover was lifted by crane on the USS Anchorage on Sept. 16 during Underway Recovery Test 3 in the Pacific Ocean.

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

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