



Kennedy Space Center's

SPACEPORT MAGAZINE



PAIR OF CONTRACTS
AWARDED TO
FLY ASTRONAUTS
PAGE 8

E-MIST EXPERIMENT
JOURNEYS TO
STRATOSPHERE
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RESCUED KENNEDY
EAGLE 'STARS' AT
TEXAS THEME PARK
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KENNEDY SPACE CENTER'S SPACEPORT MAGAZINE

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Cover: On Sept. 16, NASA announced two contracts that will enable the agency to launch its astronauts from Florida's Space Coast. These vehicles will carry four crew members and critical cargo, doubling the amount of scientific research performed on the International Space Station. Learn more on Page 8.

Back: A four-image mosaic of Comet Churyumov-Gerasimenko was taken Sept. 19 when the spacecraft Rosetta was about 18 miles away. The European Space Agency's Rosetta mission will deploy its lander, Philae, to the surface of comet Nov. 12. [NASA contributed ALICE, MIRO, and IES - plus a significant portion of the electronics package for another instrument.](#) Photo credit: ESA/Rosetta/NAVCAM

NASA'S LAUNCH SCHEDULE

Date: No Earlier Than Oct. 20-- 9:29 p.m. EDT
Mission: Orbital-3 Commercial Resupply Services Flight
Description: Launching on an Antares rocket from Wallops Flight Facility, Orbital-3 will deliver cargo and crew supplies to the ISS.

Date: Oct. 29
Mission: Progress 57
Description: Launching on a Russian Soyuz from Baikonur Cosmodrome, Kazakhstan, Progress 57 will deliver cargo and crew supplies to the ISS.

Date: Nov. 23
Mission: Expedition 42 Launch to the ISS
Description: Launching on Soyuz 41 from the Baikonur Cosmodrome, Kazakhstan, Soyuz 41 will take Terry Virts and Samantha Cristoforetti to the ISS.

Date: No Earlier Than December
Mission: SpaceX 5 Commercial Resupply Services Flight with Cloud-Aerosol Transport System
Description: Launching from Cape Canaveral Air Force Station, Fla. SpaceX 5 will deliver cargo and crew supplies to the International Space Station.

I am KENNEDY SPACE CENTER

National Aeronautics and Space Administration



DeAntae Cooper



I am a program analyst in the Resources Management Office of Kennedy Space Center Office of the Chief Financial Officer (CFO) co-located to the Launch Services Program (LSP). I support all fiscal and resources management activities related to the LSP Flight Projects Branch. One of my primary responsibilities is to ensure that the visions of the CFO -- making sure dollars make sense -- and the LSP Program are met by ensuring the program provide on-cost launch services to its customers.

My most challenging and rewarding tasks are using my acquired analytical skills to develop customized budget solutions for LSP internal and external customers. In doing so, I accommodate all the financial mission requirements for my assigned missions from inception to launch. I also enjoy the outreach opportunities and events I have participated in since joining NASA, and it is extremely rewarding to see the kids' eyes light up when they learn about NASA at these events.

To me, working for NASA is a rewarding career and far beyond my wildest dreams. I take great pride in viewing the launches of LSP missions and knowing that I am part of the team that makes it happen.

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Up, Up and Away

E-MIST experiment soars in Earth's stratosphere

BY LINDA HERRIDGE

NASA's Exposing Microorganisms in the Stratosphere (E-MIST) experiment launched to the stratosphere on the exterior of a giant scientific balloon gondola at about 8 a.m. MST on Aug. 24 from Ft. Sumner, New Mexico. Soaring 125,000 feet above the Earth, E-MIST was exposed to the upper atmosphere during a five-hour journey over the desert, to understand how spore-forming bacteria, commonly found in spacecraft assembly facilities, can survive.

"Like Mars, the Earth's stratosphere is extremely dry, frozen, irradiated and hypobaric," said David J. Smith, Ph.D., E-MIST principal investigator in Kennedy Space Center's Engineering Directorate. "Results from E-MIST may contribute to development of procedures for preventing the microbial contamination of Mars by robotic spacecraft exploration."

E-MIST was contained in a special carrier that was conceived and built at Kennedy's Prototype Development Laboratory. The 80-pound structure features four doors that rotate to expose up to 10 experimental samples each for a predetermined period of time. The structure also features a control board for autonomous operations and customizable avionics, power, environmental controls and sensors.

A team of more than 20 design, avionics, structures, analysis, science, logistics and safety engineers worked on the carrier, including Anthony Bharrat, avionics lead; Prital Thakrar, design lead and student engineer trainee from the University of Florida; and Evan Williams, an Education intern from the University of Central Florida. Nicole Dawkins, E-MIST project manager and systems engineering

Preparations are underway Aug. 24 to launch NASA's E-MIST experiment on a giant scientific balloon gondola from Ft. Sumner, New Mexico, into the stratosphere above the Earth. Photo credit: NASA/David J. Smith



lead, Smith, and engineers from NASA's Rocket University provided guidance, mentoring and support.

According to Adam Dokos, a Rocket University mentor and lead engineer in the prototype lab, some of the carrier's components were 3-D printed and others were acquired over the counter.

The carrier contained heaters to keep the samples at room temperature as they reached the stratosphere. During the flight, the four doors rotated to expose the samples, each containing up to 1 million

microbes, and to demonstrate hardware functionality, then closed again. Data was collected, including humidity, altitude, light, time and temperature, on the inside and surface of the hardware.

Bharrat said it was very exciting to start a project from the beginning and then see it fly.

"I was thrilled to see our experiment go up on the high-altitude balloon," Thakrar said. "It was especially exciting to have a live feed of the payload from the on-flight cameras during ascent. A lot of my family, friends and co-workers were watching, so I received several congratulatory phone calls during and after the flight."

"The stratosphere is an affordable and accessible proving ground for fundamental biology questions we want to answer for Mars," Smith said. "We have a whole library of spacecraft assembly facility microbes to test, and we are grateful for future flight opportunities provided by the NASA Balloon Program Office."

The NASA Balloon Program is managed by the agency's Wallops Flight Facility in Virginia. E-MIST was funded by Rocket University, a training program developed by Kennedy's Engineering and Technology Directorate and funded by NASA's Office of the Chief Engineer. [SpM](#)

Left: NASA's E-MIST experiment soars above the Earth on Aug. 24 aboard a scientific balloon from Ft. Sumner, New Mexico. Photo credit: NASA/GoPro.

I am
GSDO

National Aeronautics and
Space Administration

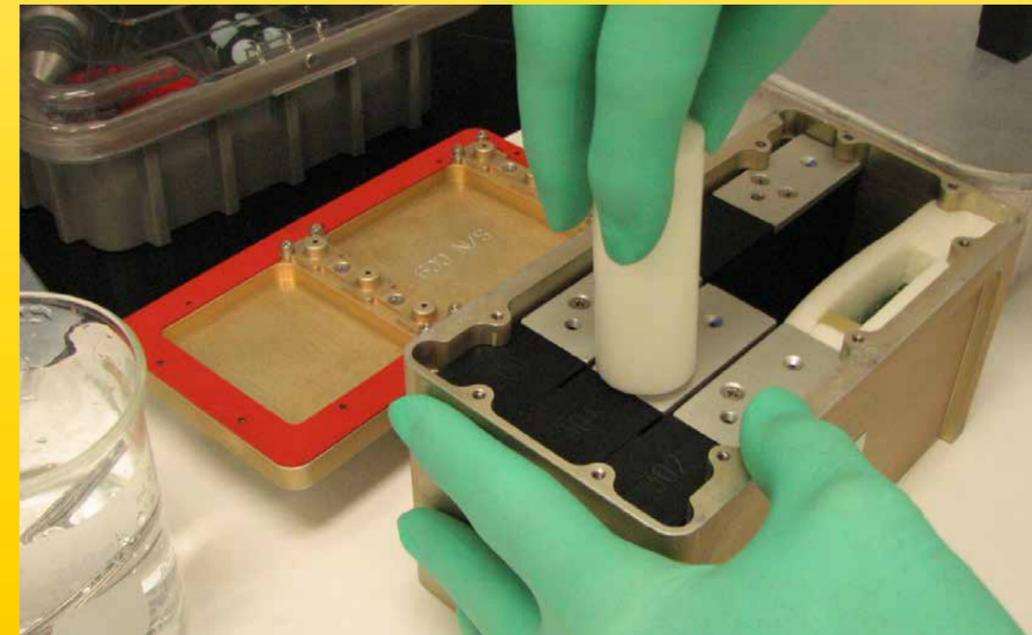


Sue Gaines Preece
Air Force Eastern Range Liaison
GROUND SYSTEMS DEVELOPMENT AND OPERATIONS



Kennedy Space Center
Exploration Begins Here

Packing for Planting



Kennedy prepped seeds for flight to space station

Several tiny seeds have begun their mission as a pathfinder for future space-grown food crops.

The University of Wisconsin-Madison sent seeds of the *Arabidopsis thaliana* plant to the International Space Station on SpaceX's fourth commercial resupply mission to learn how the microgravity environment affects their patterns of growth and gene expression.

These seeds will grow into a small flowering plant commonly used for scientific study. The plants are grown inside a canister called BRIC-19, short for Biological Research in Canisters.

The mission launched Sept. 21 on SpaceX's Falcon 9 rocket.

Just days before liftoff, the specimens arrived at Kennedy Space Center and were carefully packed into two bread box-sized Biological Research in Canisters (BRIC) containers in preparation for the ride into orbit aboard SpaceX's Dragon spacecraft.

The results of the study, called BRIC-19, could lead to a better understanding of how to grow fresh food for astronauts on future missions.

-- By Anna Heiney

To read the complete story:
<http://go.nasa.gov/1plvFVX>

a look online

more online

DYNAMIC DUO



Boeing, SpaceX race to station

BY STEVEN SICELOFF

NASA's Commercial Crew Program (CCP) remains a trendsetter in human spaceflight with the Sept. 16 naming of two companies to build the next generation of American space systems capable of carrying astronauts into low-Earth orbit. The program retained the advantages of competition by laying out criteria that permits each design to progress on its own merits through the rigorous demands of manufacturing, testing and certification.

Boeing and SpaceX each was awarded a contract to complete designs of the CST-100/ United Launch Alliance Atlas V and Crew Dragon/Falcon 9 v1.1 integrated systems, respectively, under the Commercial Crew Transportation Capability known as CCtCap. The goal of the contract is to complete the certification efforts in 2017.

However, Kathy Lueders, manager of CCP, said, "We're not going to sacrifice crew safety for that goal. We're going to work methodically with our partners as we move forward and make sure their systems can perform to the safety requirements that we have prior to being certified."

The companies will build and test the systems and, after NASA certification has been achieved, will fly two and as many as six missions to and from the International Space Station. Each post-certification mission will carry four astronauts to the station. The total potential contract value including certification, the maximum number of missions, and special study services is \$4.2 billion for Boeing and \$2.6 billion for SpaceX.

"It was not an easy choice, but it was the best choice," NASA Administrator Charlie Bolden said during the award announcement at Kennedy Space Center, home of CCP.

Competition has played a substantial role in the program. NASA has worked with eight different partners since 2010, ranging from the development of subsystems to spacecraft systems and boosters, before getting to fully integrated spacecraft and rocket designs and initial certification plans.

This final development and certification phase will see the two selected designs manufactured and flown, along with establishing the ground and mission operations architectures. Like many other elements of the program, it differs substantially from NASA's traditional approach, which was to design its own transportation system, then pick a contractor to build it.

While NASA has awarded this contract, NASA has instructed Boeing and SpaceX to stop performance on the contract while the GAO resolves a protest.



"It's really amazing to note just how much has been accomplished in such a short period of time," Lueders said. "Now we're getting to the real exciting part of final development of a system: the smoke and fire testing, the manufacturing, the flight testing, the certification of safety and then full missions to the station."

NASA's objective is to enable more research to take place on the International Space Station and to end America's sole reliance on Russia for transportation to the orbiting laboratory.

"We can double the amount of scientific research performed on the station today," Lueders said. "We'll also be able to return powered cargo with our crews and retrieve critical science

within two hours of landing. This is huge for researchers here in the U.S. who are working on time-sensitive science investigations."

The new spacecraft also will serve as lifeboats for space station crew members who could take shelter inside during emergency situations or, if the need arose, even evacuate the station. That necessity is currently carried out using Russian Soyuz capsules, each of which holds three people.

Although the announcement established the goals of the latest contract, CCP continues its involvement with partners performing work



through ongoing Space Act Agreements. SpaceX and Sierra Nevada Corporation are completing milestones under the Commercial Crew Integrated Capability (CCiCap) phase, which will see SpaceX pad and launch abort tests of the Dragon spacecraft and another Dream Chaser free-flight test, respectively. Blue Origin also is advancing its spacecraft design through

unfunded Commercial Crew Development Round 2 (CCDev2) milestones.

"We feel it's very important for the commercial industry to continue to mature their capabilities. As a program, we gain a lot of benefit from continuing to work with different partners who have different

solutions," Lueders said. "Keeping our fingers on the pulse of industry out there is critical because it continues to provide us with innovative ways for us to be able to do business together."

A week following the award announcement, CCP managers and their counterparts already were preparing for the first sessions under the Certification Baseline Review, the first milestone aimed at completing the certification process. The review will cover the design and development status of Boeing and SpaceX and their progress in meeting safety requirements necessary to achieve certification. [SPM](#)

The milestones NASA established in the contracts are a series of five progressively more advanced checkpoints that would lead to a successful certification:

- Certification Baseline Review (Scheduled to begin within 90 days of the contract start)
- Design Certification Review
- Flight Test Readiness Review
- Operational Readiness Review
- Certification Review

Another five milestones would be required to complete a mission:

- Vehicle Baseline Review
- Mission Integration Review
- Mission Certification Review
- Flight Readiness Review
- Post Flight Review

The Orion crew module, stacked atop its service module, begins its move from the Payload Hazardous Servicing Facility (PHSF) to the Launch Abort System Facility (LASF) at Kennedy Space Center. The spacecraft for Exploration Flight Test-1 was fueled in the PHSF. Inside the LASF, the Launch Abort System will be installed around the Orion spacecraft ahead of its December flight test. Orion is the exploration spacecraft designed to carry astronauts to destinations not yet explored by humans, including an asteroid and Mars. Photo credit: NASA/Dimitri Gerondidakis

For more information, visit <http://www.nasa.gov/orion>.

Orion Moves



On Course On Course



Technology Roadmaps identify technologies needed to explore solar system, deep space

Roadmaps were invented to help us understand where we are in relation to our goals and to help us find the best routes to reach our destinations.

NASA established its Technology Roadmaps with the same purpose in mind: to take stock of the current state-of-the-art technology and identify the essential capabilities needed for our exploration goals in our own solar system and in deep space through the next two decades.

“The roadmaps are really how we identify the promising technologies that can enable us to achieve our future missions,” explained Faith Chandler, director for Strategic Integration in NASA’s Office of the Chief Technologist.

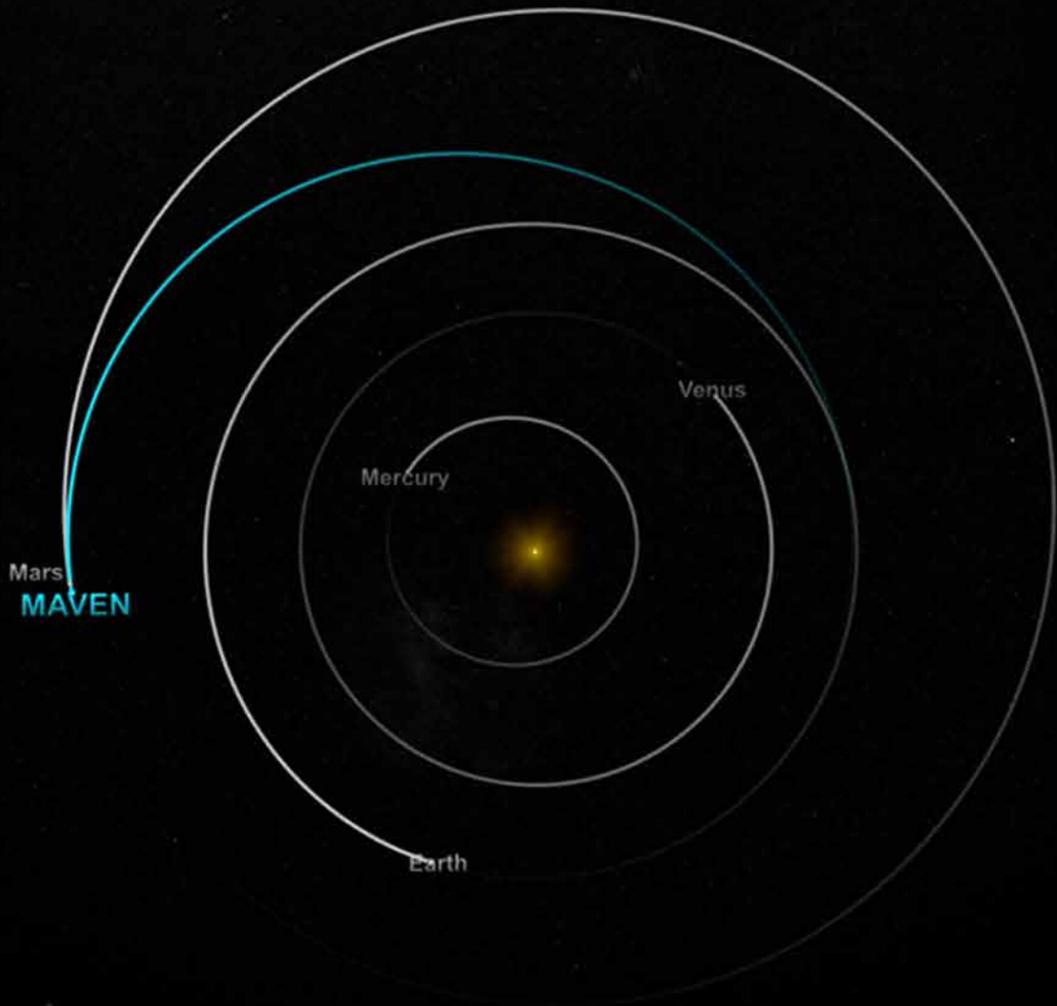
Chandler recently visited Kennedy Space Center to invite technology team members to contribute to the Technology Roadmaps, which are being updated, expanded and standardized.

-- By Anna Heiney

To read the complete story, visit:
<http://go.nasa.gov/YjcQg6>

a look online

more online



MAVEN MEETS MARS

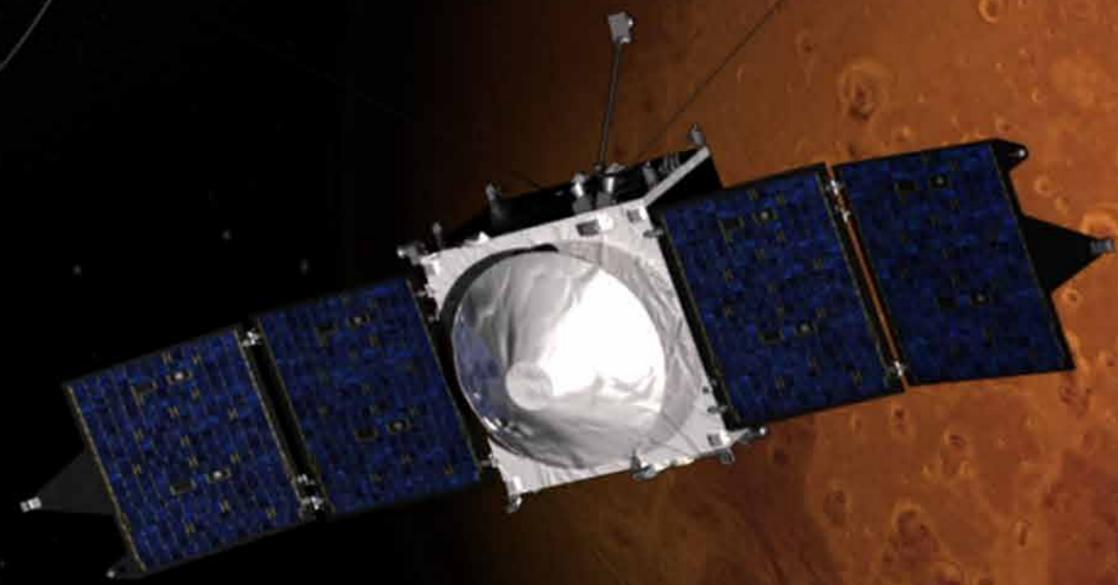
NASA's Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft successfully entered Mars' orbit at 10:24 p.m. EDT Sunday, Sept. 21, where it now will prepare to study the Red Planet's upper atmosphere as never done before. MAVEN is the first spacecraft dedicated to exploring the tenuous upper atmosphere of Mars.

Built by Lockheed Martin in Littleton, Colo., MAVEN's journey to Mars began Nov. 18, 2012. A United Launch Alliance Atlas V rocket lifted off from Space Launch Complex 41 at Cape

Canaveral Air Force Station in Florida, beginning a 10-month journey to the Red Planet.

MAVEN will study the Martian upper atmosphere in unprecedented detail from orbit above the planet taking measurements of the composition, structure and escape of gases and the planet's interaction with the sun and solar wind.

For more on MAVEN along with the past, present and future of Mars exploration, see next month's edition of *Spaceport Magazine*. [SPM](#)



A United Launch Alliance technician monitors progress as core booster elements of a Delta IV Heavy rocket are being integrated in preparation for Exploration Flight Test-1. Photo credit: NASA/Ben Smegelsky

Initial Integration

Delta IV boosters attached as next step toward first Orion flight in December

BY BOB GRANATH

Engineers took another step forward in preparations for the first test flight of NASA's new Orion spacecraft in December. The three primary core elements of the United Launch Alliance (ULA) Delta IV Heavy rocket recently were integrated, forming the first stage of the launch vehicle that will send Orion far from Earth to allow NASA to evaluate the spacecraft's performance in space.

The three Delta IV Common

Booster Cores were attached in ULA's Horizontal Integration Facility (HIF) at Cape Canaveral Air Force Station in Florida. The HIF building is located at Space Launch Complex 37 where the mission will lift off.

The first booster was attached to the center rocket in June with the second one attached in early August.

"The day-to-day processing is performed by ULA," said Merri Anne Stowe of NASA's Fleet Systems Integration

Branch of the Launch Services Program (LSP). "NASA's role is to keep a watchful eye on everything and be there to help if any issues come up."

Stowe explained that during major testing experts from NASA's Launch Services Program monitor the work on consoles in Hanger AE at Cape Canaveral Air Force Station. Hanger AE is home to the Kennedy Space Center's upgraded Launch Vehicle Data Center. The facility

A transporter for oversized loads carries the port, or left, booster for the United Launch Alliance Delta IV Heavy for Exploration Flight Test-1 (EFT-1) into the Horizontal Integration Facility, or HIF, on May 7 at Space Launch Complex 37 on Cape Canaveral Air Force Station. Photo credit: NASA/Kim Shiflett



Two of the three United Launch Alliance Delta IV heavy boosters for NASA's upcoming Exploration Flight Test-1 mission (EFT-1) which will launch the Orion spacecraft, arrive at the U.S. Army Outpost wharf at Port Canaveral on March 4, 2014. Photo credit: NASA/Kim Shiflett



allows engineers to monitor voice, data, telemetry and video systems that support expendable launch vehicle missions. Kennedy also is where Orion was built and is being processed.

The Delta IV rocket stages were assembled at the ULA plant in Decatur, Alabama, about 20 miles west of Huntsville. After completion, the rocket components were shipped down the Tennessee River and Tombigbee Waterway, a canal, to the Gulf of Mexico. From there they traveled to Cape Canaveral, arriving on May 6. The elements of the rocket's first stage then were transported to the HIF for

preflight processing.

"After the three core stages went through their initial inspections and processing, the struts were attached, connecting the booster stages with the center core," Stowe said. "All of this takes place horizontally."

The three common booster cores are 134 feet in length and 17 feet in diameter. Each has an RS-68 engine that uses liquid hydrogen and liquid oxygen propellant producing 656,000 pounds of thrust. All totaled, the three Delta IV boosters collectively generate 1.96 million pounds of thrust.

The second stage of the Delta IV rocket is 45 feet in

length and 17 feet in diameter. It uses one RL10-B-2 engine, also burning liquid hydrogen and liquid oxygen propellant creating 25,000 pounds of thrust.

"The second stage was taken to the Delta Operations Center for processing after it arrived," said Stowe. "The second stage was moved to the HIF on Aug. 29 and is scheduled to be horizontally mated to the first stage on Sept. 12."

The same upper stage will be used on the block 1 version of NASA's new heavy-lift rocket, the Space Launch System (SLS). More powerful than any rocket ever built, SLS will be capable of sending humans

aboard Orion to deep-space destinations such as an asteroid and Mars.

"The hardware for Exploration Flight Test-1 is coming together well," Stowe said. "We haven't had to deal with any serious problems. All of the advance planning appears to be paying off."

Once all the launch vehicle stages are mated and thoroughly checked out, the next step is the Test Readiness Review.

"These meetings are held to bring together all the interested parties to be sure the Delta IV rocket is ready for the move to the launch pad where the Orion spacecraft

will be mated," Stowe said.

The upcoming flight test will use the Delta IV Heavy to launch the Orion and send it 3,600 miles in altitude beyond the Earth's surface. During the two-orbit, four-hour mission, engineers will evaluate the systems critical to crew safety, the launch abort system, the heat shield and the parachute system. The data gathered during the mission will influence design decisions and validate existing computer models. The flight also will reduce overall mission risks and costs for later Orion flights.

The capsule will re-enter Earth's atmosphere at speeds approaching 20,000 mph,

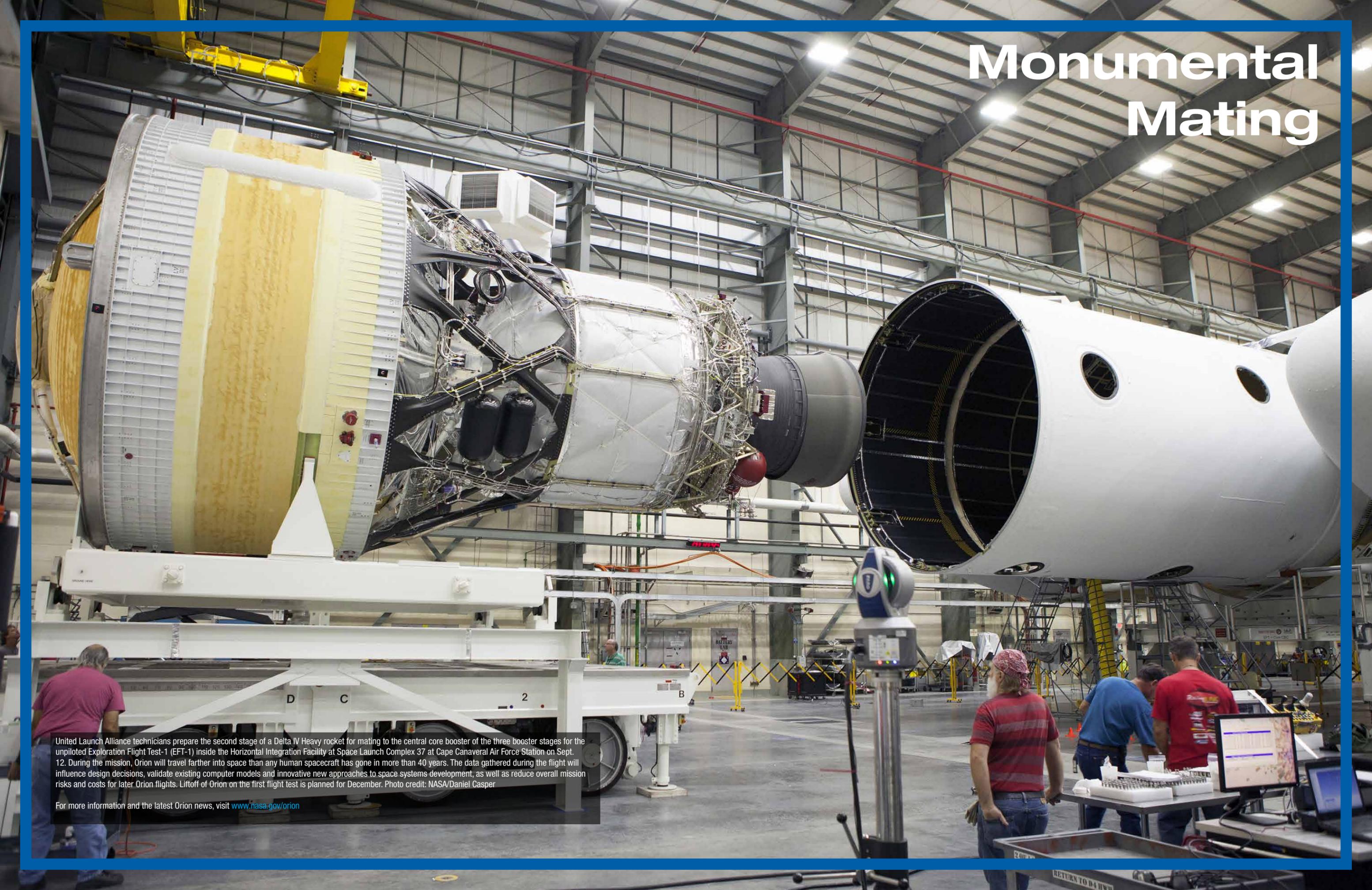
generating temperatures as high as 4,000 degrees Fahrenheit, before splashing down in the Pacific Ocean.

The Lockheed Martin-built Orion is designed to take humans farther than ever before. The spacecraft will serve as the exploration vehicle that will carry astronauts to space and provide safe re-entry from deep-space missions. Orion currently is at Kennedy's Launch Abort System Facility.

Stowe is especially invested in a successful outcome for the flight test.

"What I'm looking forward to most," she said, "is seeing that Orion capsule being retrieved from the Pacific." [SPM](#)

Monumental Mating



United Launch Alliance technicians prepare the second stage of a Delta IV Heavy rocket for mating to the central core booster of the three booster stages for the unpiloted Exploration Flight Test-1 (EFT-1) inside the Horizontal Integration Facility at Space Launch Complex 37 at Cape Canaveral Air Force Station on Sept. 12. During the mission, Orion will travel farther into space than any human spacecraft has gone in more than 40 years. The data gathered during the flight will influence design decisions, validate existing computer models and innovative new approaches to space systems development, as well as reduce overall mission risks and costs for later Orion flights. Liftoff of Orion on the first flight test is planned for December. Photo credit: NASA/Daniel Casper

For more information and the latest Orion news, visit www.nasa.gov/orion

PREPARING FOR SPLASHDOWN

Third round of Orion Underway Recovery Tests helps support teams prepare for December flight

BY LINDA HERRIDGE

NASA, Orion prime contractor Lockheed Martin and the U.S. Navy successfully completed the third round of tests to practice recovering Orion when it splashes down off the coast of San Diego at the end of its December flight test. The mid-September test series, led by NASA's Ground Systems Development and Operations (GSDO) Program, continued to perfect techniques and ensure the full team and all equipment are ready when Orion returns to Earth after traveling more than 3,600 miles above the planet.

Two Navy ships, a test version of Orion, several support boats, two helicopters and associated hardware and equipment were used for the tests.

The teams practiced two methods for recovering Orion. The first test began Sept. 11 at Naval Base San Diego, with loading of the test vehicle, equipment and hardware aboard the USNS Salvor (T-ARS 52), a safeguard-class rescue and salvage ship. Also on board were Navy radiomen and a civilian crew. The



The tethered Orion boilerplate test vehicle is secured in the well deck of the USS Anchorage during the third day of Orion Underway Recovery Test 3 in the Pacific Ocean on Sept. 17. Photo credit: NASA/Cory Huston

ship headed out to sea Sept. 12 to test a backup recovery method using the ship's stationary crane.

"The test was a success thanks to the expertise of the Salvor crew, Navy divers and the Department of Defense," said Marcos Pena, GSDO Technical Integration lead for crane recovery.

"Recovery of the Orion crew module is essential to the success of Orion's flight test and subsequent Orion and Space Launch System missions in the years to come."

Starting in calm seas, the team used a 40-ton aft boom

crane attached to the Navy ship to retrieve the 20,000 pound Orion test vehicle from the water.

They continued recovery efforts in more challenging waters to determine recommended weather and

sea condition limits for crane recovery.

During this test, Navy divers practiced attaching a "horse collar" around Orion and four tending lines that helped control lateral and longitudinal motion during crane recovery.

The team also evaluated a basket lift rigging, consisting of 10 slings that were placed around Orion during crane lift operations.

“The basket lift rigging was tested previously on the USS Anchorage,” said Pena. “We were able to take the next step and demonstrate that the basket lift rig and horse collar can be used to lift the test vehicle over the side of the ship and set it on a cradle on the ship’s deck, all while maintaining motion control.”

Tether lines from the ship were attached to Orion for towing tests at various speeds and can be used to bring the capsule to calmer waters for recovery.

On Sept. 15, the USNS Salvor rendezvoused with the USS Anchorage in the open sea and handed off the Orion test vehicle for the next portion of the recovery test.

During the week, the team performed an

end-to-end recovery simulation using the ship’s well deck, two of the Navy’s Zodiac boats, four rigid hull inflatable boats, two helicopters and equipment and procedures that were used during August testing.

U.S. Navy divers in Zodiac boats and other team members in rigid hull inflatable boats were stationed in the water near the test vehicle. Orange stabilizers on the top of the test vehicle were inflated to simulate the system that will be used to upright Orion in the water after splashdown.

Using tether lines attached to the test vehicle, the team guided Orion back to the ship. In the well deck, NASA and Lockheed Martin workers set up a capture net, crew module recovery cradle, wing well fenders, speed bumps, and used a recovery winch, horse collar and Kevlar tending lines to stabilize Orion in the well deck.



A rigid hull inflatable boat containing U.S. Navy divers and other personnel approaches the Orion boilerplate test vehicle floating in the Pacific Ocean, a distance away from the USS Anchorage, during the third day of Orion Underway Recovery Test 3 on Sept. 17. Photo credit: NASA/Cory Huston



The Orion boilerplate test vehicle was lifted by stationary crane off the side of the USNS Salvor, a safeguard-class rescue and salvage ship, during Underway Recovery Test 4A in the Pacific Ocean on Sept. 14. Photo credit: NASA/Kim Shiflett

During the week, they also practiced retrieving a mock-up of Orion’s forward bay cover, a shell that fits over Orion’s crew module to protect the spacecraft during launch, orbital flight and re-entry.

“Successful completion of this test series marks a significant milestone in NASA’s partnership with the Navy to recover the Orion crew module after it splashes down in the Pacific Ocean in December,” said Jeremy Graeber, GSDO NASA Recovery director. “The integrated team has done an amazing job working to refine the procedures to make this mission a success. I feel confident that our team and hardware are ready to support Exploration Flight Test-1.”

Other goals of the test were to assess on-ship communications and ship-to-shore communications, as well as to record timing data for recovery activities to help provide future recovery methods for crewed missions.

The USS Anchorage returned to Naval Base San Diego on Sept. 19 where the Orion test vehicle and recovery equipment were offloaded from the ship. [SpM](#)

This Eagle Has Landed

Bird rescued at Kennedy 'stars' in educational program in Texas

BY BOB GRANATH

A nesting bald eagle, blown from its nest during a storm that passed through Kennedy Space Center in early 2013, now is the star of an educational program at a theme park in San Antonio, Texas. One of the ecologists who rescued the bird recently visited the site where the eagle is part of a program that is delighting guests of all ages.

"She is incredible, very large, a good learner and has a nice temperament," said Becky Bolt, a wildlife ecologist with InoMedic Health Applications Inc. (IHA). "Her trainers absolutely adore her."

When a thunderstorm passed through the Space Coast on the afternoon of March 24, 2013, it pounded the area with heavy rain, hail and winds exceeding 60 miles per hour. Two eaglets were blown to the ground along with their nest. Fortunately, ecologists at Kennedy stepped in and rescued them.

With assistance from the Merritt Island National Wildlife Refuge, both birds were collected and taken to the Audubon Center for Birds of Prey in Maitland, Florida. The center provides medical treatment,



rehabilitation and release of Florida's raptors.

Two days after the rescue, one eaglet was returned to the area where he was found. The bird was placed in a nest box, built by wildlife experts, with a wooden frame, wire mesh in the bottom and filled with twigs and straw. He was fed and raised by his parents and fledged (ready to fly) three weeks later.

The second eaglet remained at the Audubon Center where treatment continued for an eye problem. It was found that she had clear vision in only one eye.

"The veterinarians at Audubon determined that the eagle could not survive in the wild with only one good eye," Bolt said. "She was given to SeaWorld in Orlando to be trained for educational programs."

Eight months later, the eagle was sent to SeaWorld in San Antonio. According to their website, "Guests are often surprised to be greeted by one of our many animal ambassadors, many of whom were orphaned or injured in the wild and given a second chance thanks to our SeaWorld Rescue Team."

The SeaWorld animal encounters now include



Wildlife ecologist Becky Bolt holds one of the eaglets rescued March 26, 2013. Photo credit: InoMedic Health Applications/Russ Lowers



Missy Lamar of SeaWorld San Antonio holds "Star." Photo credit: InoMedic Health Applications

what is described as the "grace and nobility of the magnificent eagle."

During her recent visit to San Antonio, Bolt noted that wildlife conservation experts at the Texas SeaWorld named the eagle "Star."

"For many people, this may be their only opportunity to see an eagle up close," she said. "Kids, especially, enjoy seeing the bird one-on-one."

During the educational presentations, guests learn that bald eagles do not gain the distinctive white feathers on their heads until they are about five years old. The average weight of an adult female bald eagle is 10 to 14 pounds. In captivity, eagles are known to live up to 50 years, due to a controlled environment, nutrient-rich diet and veterinary care.

Bolt explained that "Star" is still "only a baby."

"She is 16 months old and weighs about nine pounds," she said. "Even so, she is a big bird and people love seeing her. Now they will hear her story and gain a better appreciation for eagles." [SpM](#)



Research Resupply

Brilliant night launch kicks off scientific cargo run to ISS

BY STEVEN SICELOFF

An eruption of fire and smoke sent a SpaceX Dragon spacecraft skyward laden with 5,000 pounds of scientific equipment and supplies destined for use by the crew of the International Space Station.

Two days later, the uncrewed spacecraft approached the station carefully so astronauts on the orbiting laboratory could latch onto it with the station's robotic arm and connect the Dragon in place for unloading.

"This launch kicks off a very busy time for the space station," said NASA's Sam Scimemi, director of the International Space Station, noting upcoming launches of a Soyuz carrying the next crew

of the station and launches of cargo spacecraft within a month.

Lifting off at 1:52:03 a.m. EDT on Sept. 21, from Launch Complex 40 at Cape Canaveral Air Force Station, Florida, the SpaceX Falcon 9 rocket and Dragon etched a yellow and white arc across the sky as it flew on a path roughly paralleling the East Coast of America. The nine Merlin 1D engines of the first stage shut down as planned about 2 minutes and 41 seconds into flight and the single Merlin engine of the second stage ignited to carry the Dragon the rest of the way into orbit.

Cheers greeted the video from Dragon as the second stage pushed itself away from the orbit-bound spacecraft, and a pair of solar array "wings" unfolded to recharge the Dragon's batteries.

"There's nothing like a good launch, it's just fantastic," said Hans Koenigsmann, vice president of Mission Assurance for SpaceX. "From what I can tell, everything went perfectly."

The launch began a two-day chase of the space station that ended when European Space Agency astronaut Alexander Gerst and NASA astronaut

Reid Wiseman snagged the uncrewed Dragon with the station's robot arm and maneuvered the capsule onto a port of the station. The station crew will unload the equipment and supplies inside the Dragon, including a glovebox-sized habitat holding 20 mice that will be used for microgravity research into bone density.

The Dragon carried the elements needed for some 255 scientific investigations the crew members of Expeditions 41 and 42 will conduct. A device called ISS-RapidScat that will measure the winds on the Earth's ocean made the trip bolted inside the unpressurized trunk of the Dragon. It will be connected to the outside of the Columbus module on the space station to make its observations. The readings are expected to improve weather forecasting and hurricane monitoring.

Along with the mice and RapidScat, the Dragon's payload included the first 3-D printer taken into space. The experiment is to demonstrate the potential to produce parts in orbit cheaply and on-demand instead of having to wait for them to be made on Earth and shipped

into orbit on a cargo craft. The technology could be invaluable for future trips into deep space. The microgravity findings also are expected to refine 3-D printing on Earth.

A plant experiment carried into orbit will evaluate the growth and development of *Arabidopsis thaliana* seedlings. These seeds will grow into a small flowering plant commonly used for scientific study. The plants are grown inside a canister called BRIC-19, short for Biological Research in Canisters.

This mission was the fourth SpaceX cargo flight to the station by a Dragon spacecraft, counting the first test flight in May 2012.

The Dragon and Orbital Sciences' Cygnus spacecraft have become regular visitors to the space station as they deliver the supplies and equipment that allow groundbreaking research in a wide array of fields to take place.

The Dragon is to leave the station in mid-October for a plunge through Earth's atmosphere and a landing under parachutes in the Pacific Ocean where it will be recovered. [SpM](#)

Ready, Set, Stow

SpaceX CRS-4 payload processed by Kennedy team

BY LINDA HERRIDGE

Engineers and technicians frequently load perishable cargo and time-sensitive scientific investigations into spacecraft destined for the International Space Station (ISS) just hours before liftoff. At Kennedy Space Center, the ISS Ground Processing and Research Project team has become expert at the process and geared up to get crucial late stowage cargo on SpaceX's Dragon spacecraft destined for the orbiting laboratory.

For SpaceX's fourth contracted commercial resupply mission to the space station, that lifted off from Cape Canaveral Air Force Station (CCAFS) on Sept. 21, several NASA and contractor workers outfitted 16 different hardware and science labs in Kennedy's Space Station Processing Facility (SSPF) for 61 principal investigators, including 17 from other countries, as they prepared

their science experiments for flight.

"Our role was to ensure that all of the necessary laboratory equipment, supplies and consumables were readily available and met customer requirements," said Rob Kuczajda, ISS Utilization project manager in the ISS Research and Utilization Office.

Various powered and pressurized experiment containers were readied at Kennedy for a multitude of science experiments that were part of the cargo loaded soon before launch. These included powered lockers for the Commercial Generic Bioprocessing Apparatus (CGBA), the Animal Enclosure Module Transporter (AEM-T) and the General Laboratory Active Cryogenic ISS Experiment Refrigerator (GLACIER) which holds a NanoRack module, a drug metabolism syringe kit and a bone densitometer.

The CGBA will provide automated biological processing and temperature

control for the Micro-8 investigation. The AEM-T will be used to launch rodents to the space station. GLACIER is an ultra-cold refrigerator/freezer that will store samples at temperatures as low as minus 301 degrees Fahrenheit.

Two unpowered lockers were prepared to hold experiments from the Japan Aerospace Exploration Agency and food for the space station crew, while a variety of unpowered hardware bags also were readied to carry 16 different experiments, including Biologic Research in Canisters 19 and plant gravity sensing experiments. Included for late stow were experiments from the Center for the Advancement of Science in Space (CASIS) for the ISS National Laboratory.

“This is an important time for the space station program,” said Kuczajda. “There is an effort to maximize the science utilization on the space station.”

Teams at Kennedy also helped prepare other experiments for the trip to the space station in other ways. NASA’s ISS-RapidScat external payload also was delivered to the space station on SpaceX’s mission. Built at NASA’s Jet Propulsion Laboratory in Pasadena, California, RapidScat is the first in a series of NASA Earth-observing instruments designed to operate outside the space station. It will measure Earth’s ocean surface wind speed and direction, providing data for weather and marine forecasting.

According to Kuczajda, his team’s involvement with RapidScat started much earlier in the processing flow than normal. A small team of engineers and technicians went to JPL in July 2013 during manufacture of the payload in order to assist with the integration of an element of the experiment.

“JPL requested our assistance because we had performed this type of work on other space station hardware in the past,” Kuczajda said.

When the payload arrived at Kennedy in May, the team supported its offload from the truck and setup in the SSPF. Kennedy engineers supported a final end-to-end verification test in the Payload Rack Checkout Unit that same month to ensure the payload would perform as designed in orbit. Kennedy transported the external payload to the SpaceX payload processing facility June 25, and it was loaded into the Dragon trunk June 26.

The day before launch, the Kennedy team transported all of the late-load science experiments and hardware to SpaceX at Launch Complex 40 at Cape Canaveral Air Force Station, and oversaw their installation into the Dragon capsule.

“It’s exciting to play a part in ensuring some very important science is delivered to the space station,” Kuczajda. “Knowledge obtained from these investigations will play a direct role in supporting NASA’s vision of deep space human spaceflight.” [SpM](#)



April Spinale, a payload integration specialist with Bionetics, fills vials with clear water Sept. 10 during an acceptance leak test on the hardware for the Protein Crystal Growth 2 experiment inside a laboratory at the Space Station Processing Facility at Kennedy Space Center. Photo credit: NASA/ Dimitri Gerondidakis



ENSURING EXPECTATIONS

Team offers unique insight to ensure safety, reliability of spacecraft software

BY STEVEN SICELOFF

The new approach NASA is taking to get its crews to low-Earth orbit with commercial partnerships requires the space agency to closely examine the plans companies have for their own space transportation systems to ensure they are as safe and reliable as can be.

Reviewing software, for example, has become increasingly important in aerospace as technology has become more complex, and computers are required to take on more and more of the operation of systems. Simply put, computer programs can detect the need to make adjustments, then execute those adjustments in a fraction of the time it would take a person to even turn his or her head to read an instrument. Software also can handle the mundane, everyday aspects of a spacecraft to free up astronauts and crew for unique tasks.

That's where a specialized team of software architecture analysts comes in. NASA's Independent Verification and Validation group evaluates spacecraft software for weaknesses and identifies ways to fix problems from a number of perspectives. The work is done so the agency can offer insight into company plans throughout their partnerships with the Commercial Crew Program, or CCP.

"The team has a very strong software background in a variety of areas," said Norman Peters, one of the Safety and Mission Assurance project engineers working with CCP. "Whether it's human flight or touching down on Mars, they've been involved. So they'll look at a system like the environmental control system and if software is involved and it might be a cause of a problem, they let us know."

It's a big task that involves analyzing sets of documents, scrutinizing each sentence and comparing it to NASA's historically stringent requirements. From standards to hazard reports to

examinations of testing regimens, the plans for each subsystem, system and the spacecraft as a whole see intense inspections.

"Hazard reports are anywhere from a few dozen pages to hundreds of pages, and we've had several hundred that we've had to review between all partners," Peters said.

And that's just for the software that will operate the systems. Another whole other set of requirements and reviews is used to survey the hardware.

"There's no way one person could do it or know everything there is to know about these systems," Peters said.

The software reviews to this point have not taken a deep dive into coding or running a company's program through a simulator. Instead, the team has been looking over sets of standards each partner says it is using to guide software development and ensures they meet the intent of requirements NASA set up throughout the agency's decades of spaceflight experience.

"In some respects it is like translating between foreign languages,



but generally we look at the prime software standard, which has roughly 140 requirements, and compare partner standards to that," Peters said. "And with multiple partners, we have to make sure we're being fair and consistent and we're looking at it the same way. We're looking at it from a safety and mission assurance perspective

rather than from an engineering perspective.”

Encouraged by NASA to add their own innovations into spacecraft systems, the partners developed everything from new thrusters and escape systems to different engineering guidelines specifically tailored to their corporate needs and culture.

“When a provider presents an alternate standard, we assess what they give us against what we believe is the intent of the NASA standards. We provide an analysis of the gap between the two and determine whether we think the alternate is meeting the intent of the standard,” said Kathy Malnick, team lead in the Safety and Mission Assurance Support Office group at NASA’s IV&V Program.

The evaluation criteria focuses on safety and reliability but is greatly reduced from the list NASA uses during its own spacecraft development because the commercial companies are not obligated to set up a management and related workforce structure in the same manner NASA would.

“I think the total number of requirements levied has been reduced dramatically, so our job is to ensure that full level of intent has been met,” said Chad Schaffer, who is with contractor TASC and reviews the hazard reports from CCP’s aerospace partners. “CCP is definitely unique in that NASA’s really trying to take a different approach, reducing the amount of overhead to try to streamline and let commercial space add value at a cost point that’s going to work for the future.”

The small support team also includes Ken Costello, Ryan Schmitt, Rhonda Fitz, Pat Cuyno and Mel Rother.

“The first time I got reviews back I was amazed,” Peters said. “I never expected the quality of data that they provided, and later on, it got to be where I would call in and say we need something and I don’t have much time, and they’d come through every time.”

The group recently earned Spaceflight Awareness honors from the Safety and Mission Assurance branch at Kennedy Space Center, the parent organization for the group.

“The team provides invaluable expertise to the commercial crew safety and mission assurance effort with independent review and assessment of our commercial partner’s software standards, processes and hazard reports,” said Russ Deloach, deputy director of Safety and Mission Assurance at Kennedy. “Their work is extremely important to the overall safety and success of the program as software provides many critical control functions that could have catastrophic consequences if performed incorrectly. Their hard work and dedication is admirable.” [SpM](#)

Oxidizing Oranges



Citric acid tests underway at corrosion lab and beachside test facility

Who would have thought that oranges and other citrus fruit would be good for more than eating? Now, the citric acid that these fruits contain also could be used to protect stainless steel equipment and structures at Kennedy Space Center.

The Technology Evaluation for Environmental Risk Mitigation (TEERM) Principal Center in NASA’s Environmental Management Division has partnered with the Ground Systems Development and Operations program at Kennedy to investigate citric acid as an alternative to nitric acid for protecting a specific set of stainless steel alloys currently used in ground support equipment and structures, including pipes, at the center.

Phase I testing began in late 2012 and concluded in April 2014. Several different tests were completed on stainless steel samples in the Corrosion Technology Lab in the Operations and Checkout Building and the Beachside Atmospheric Test Facility at Kennedy. -- *By Linda Herridge*

To read the complete story, visit <http://go.nasa.gov/1qFD9Yt>

a look online

more online

FAMILY REUNION

Annual Tom Joyner gathering encourages STEM education

BY BOB GRANATH

NASA's Education Division at Kennedy Space Center recently joined radio host Tom Joyner in touting the benefits of studying math and science along with career opportunities offered by the space agency. Attended by thousands of guests, the event took place at the Gaylord Palms Resort in Kissimmee, Florida, during the Labor Day weekend.

The Allstate Tom Joyner Family Reunion is an annual event, now in its 11th year, and is designed to present uplifting programs, entertainment and educational information about growing, diverse communities.

The exposition included many displays with NASA's participation focusing on encouraging young people to consider studies and careers in STEM disciplines -- science, technology, engineering and math.

Agency representatives were on hand to explain NASA's current efforts with the International Space Station, Commercial Crew, Ground Systems Development and Operations, as well as the Launch Services Programs. At the same time, participants had an opportunity to engage with NASA experts and ask questions



Now a senior vice president at the Florida Institute of Technology, Winston Scott signs autographs and poses for pictures with guests at the Allstate Tom Joyner Family Reunion during Labor Day weekend. Photo credit: NASA/Dan Casper

about space, education and careers.

"Our participation is in line with our strategic goal to get the community and, for that matter, the world interested in NASA's work," said Priscilla Moore, a lead education program specialist in NASA External Relations at the Kennedy Space Center. "Many kids from the Central Florida area and from around the state are from underrepresented groups. We want to show these young people what NASA is all about, what STEM is all about and that science,

technology, engineering and math are fun."

Pamela Covington, manager of NASA Office of Communications at the Stennis Space Center in Mississippi, was on hand to assist with the Kennedy Space Center's participation. She agreed that inspiring students was a key message of the agency's exhibit.

"This is an opportunity to tell people the space program is alive and well and remind them of its many benefits and economic relevance," she said. "We also want to encourage young people to study math and science, and consider careers with NASA."

As host of The Tom Joyner Morning Show, the nationally syndicated radio personality also is the founder of REACH Media Inc. and the Tom Joyner Foundation.

Joyner grew up in Tuskegee, Alabama. His father served during World War II as a member of the famed Tuskegee Airmen, the first group of African-American military combat pilots. Following graduation from Tuskegee Institute (now Tuskegee University) in 1970, Joyner began his career in radio.



"Learn and Spin Challenge" was an opportunity for guests to answer questions related to science, technology, engineering and math. Debbie Houston of Aerospace Medicine and Occupational Health in NASA Center Operations, right, gives a prize for participation. Photo credit: NASA/Dan Casper



Ken Fullwood of Booz-Allen-Hamilton, left, and Yves Lamothe of the NASA Technical Management Branch of the Ground Systems Development and Operations Program talk to guests about ongoing work to convert the Kennedy Space Center into a 21st century spaceport. Photo credit: NASA/Dan Casper

"The Kennedy Education Division has been participating since 2010," Moore said. "Kennedy's continued success is directly tied to our most valuable asset -- our workforce. To continue to lead the world into space, we must



Brittani Sims, left, and Sheldon Lauderdale both work in the Program Control and Integration Office of the Commercial Crew Program. They talked to visitors about NASA's Commercial Crew Program. Photo credit: NASA/Dan Casper

show our children the possibilities that await them in the technology and engineering fields.”

A highlight of the event was an appearance by former astronaut Winston Scott, who encourages young people to follow in his footsteps and those of others now working as scientists and engineers with NASA.

“We want them to know that there are a lot of exciting things to do in life,” he said. “Education is first and foremost, that’s got to be No. 1. Get a good education and identify some things they like to do in life and they’ll be prepared for opportunities to be successful.”

Raised in Miami, Scott graduated from Florida State University in 1972. After serving as a pilot in the U.S. Navy, he became an astronaut in 1992, flying two space shuttle missions, STS-72 in 1996 and STS-87 in 1997.

Now retired from NASA and the Navy, Scott is senior vice president of the Office of External Relations and Economic Development at the Florida Institute of Technology in Melbourne, Florida.

“My primary job is to expand the Florida Tech Research Park,” he said.

According to the Florida Tech website, the research park is a self-sustaining center focused on facilitating the creation and application of innovative solutions for government and industry.

Additionally, Scott spends time with students.

“I talk to them in different classes in engineering and aeronautics and other activities, and I emphasize how important it is to get a good education and prepare for all the things the future holds,” he said. “There are new and different opportunities coming along every day that are just fascinating. We want our students to be prepared to take their place and participate in some of those fascinating things.”

During the five-day reunion, visitors also had an opportunity to take part in hands-on science projects such as a rocket building and launch experience, as well as a “Learn and Spin Challenge” with emphasis on STEM-related questions. A robotic exhibit demonstrated to students that it is fun to channel their creativity and energy toward science and technology. A robot workshop introduced students to basic robotics by engaging them in building and operating small sensor-based robots.

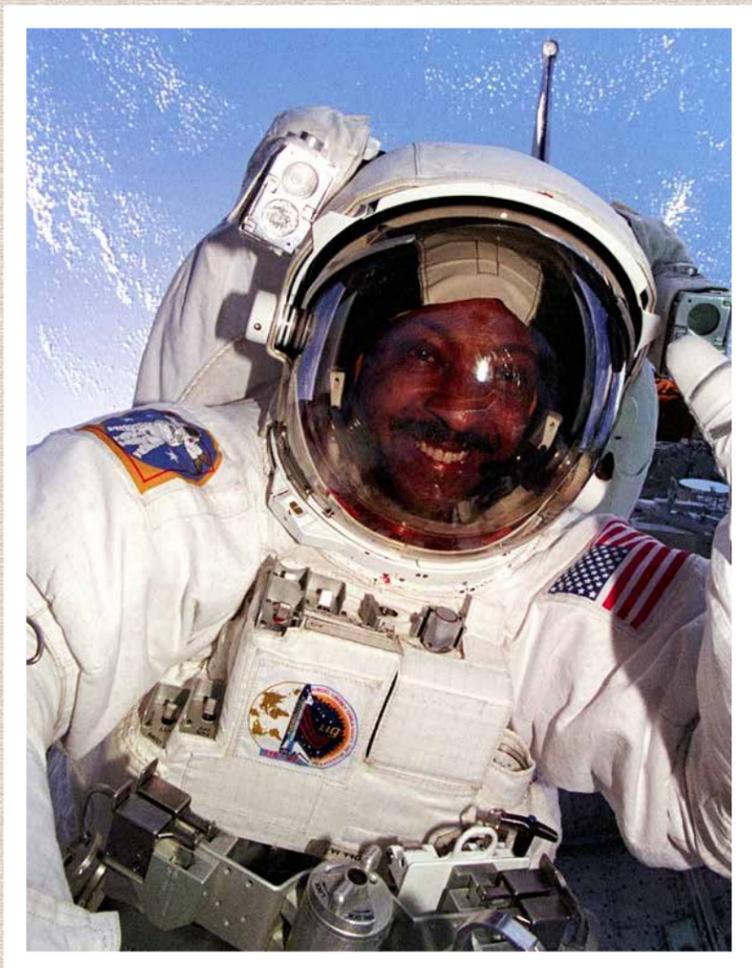
Other hands-on activities included a “Rocket Science 101” touch-screen computer game involving how NASA launch vehicles work, and tangram puzzles were available in which participants were responsible for patching up a space vehicle that had been hit with a micrometeorite. Tangrams are geometric puzzles consisting of flat shapes cut into pieces, which are put together to form other shapes.

“College Day was an opportunity for college-bound students to network with college and university educators,” Moore said. “It included a panel discussion with our higher education specialists participating with more than 15 historically black colleges and universities, traditional colleges and other higher education organizations.”

Moore noted that the National Science and Technology Council’s Committee on STEM (CoSTEM) Education has challenged NASA Education to continue to provide opportunities for learners to participate in STEM education activities. According to the report, the approach should capitalize on the agency’s unique assets and content

to ensure that one million elementary and secondary students participate in NASA STEM engagement opportunities over the next five years.

“What better way to accomplish these challenges than an event such as the Tom Joyner Family Reunion that attracts people from all over,” she said. “We want to continue to show children and their parents the possibilities that await them in NASA and the STEM fields.” [SpM](#)



Photographed in the space shuttle Columbia’s cargo bay, STS-87 mission specialist Winston Scott waves to crewmates during a spacewalk on Dec. 3, 1997. Photo credit: NASA

Significant Progress

NASA OK's Ground Systems' progression to world's premier multi-user spaceport

BY RACHEL KRAFT AND LINDA HERRIDGE

NASA's Ground Systems Development and Operations (GSDO) Program continues to make significant progress preparing Kennedy Space Center to launch the agency's Space Launch System (SLS) rocket and Orion spacecraft that will take humans to new destinations in the solar system, including an asteroid and Mars.

NASA announced Sept. 10 that the agency has completed a rigorous review process to transform Kennedy from a traditionally government-only launch complex to the world's premier multi-user spaceport. Marking the completion of the milestone, NASA officials approved the program's progression from formulation to development.

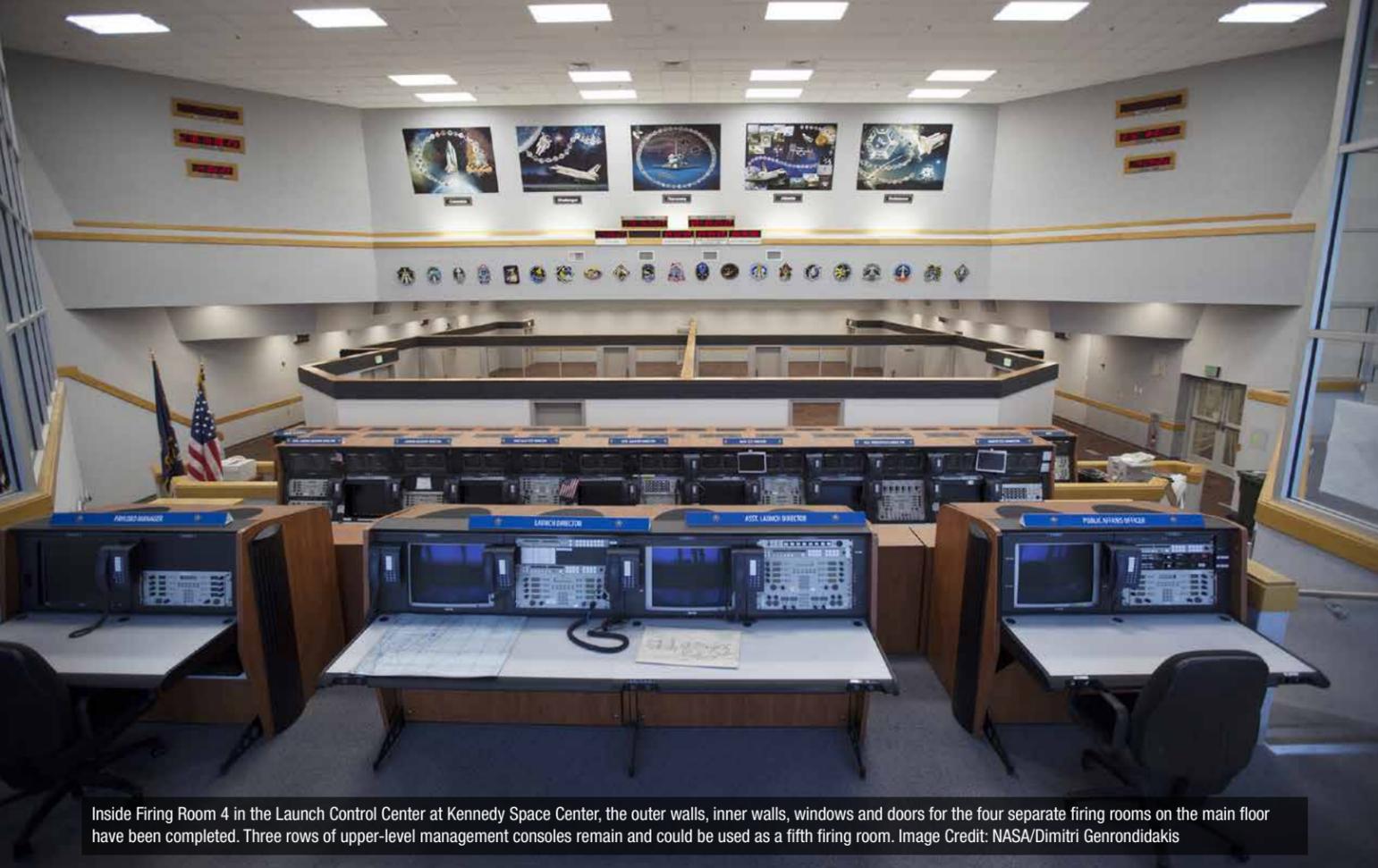
The approval is part of a thorough evaluation known as Key Decision Point C (KDP)-C, and provides a development cost baseline of \$1.844 billion from Fiscal Year 2014 through a launch readiness date of no later than November 2018.

Conservative cost and schedule commitments outlined in the KDP-C align the GSDO program with program management best practices that account for potential technical risks and budgetary uncertainty beyond the program's control.

"The GSDO program has performed extremely well in developing and implementing solid plans that will support the launching systems of the future," said William Gerstenmaier, associate administrator for NASA's Human Exploration and Operations. "These ground systems will be critical to the support of SLS and Orion. Tremendous progress has been made over the past several years on Vehicle Assembly Building modifications, pad upgrades and mobile launcher upgrades. Today at Kennedy, you can see many of the major components of the launch



Modifications continue on the Mobile Launcher (ML) at the Mobile Launcher Park Site at Kennedy Space Center. A crane is in place to lift a new steel beam for installation on the ML structure. The ML is being modified and strengthened to carry NASA's Space Launch System rocket and Orion spacecraft to Launch Pad 39B for its first uncrewed mission, Exploration Mission-1. Image Credit: NASA/Cory Huston



Inside Firing Room 4 in the Launch Control Center at Kennedy Space Center, the outer walls, inner walls, windows and doors for the four separate firing rooms on the main floor have been completed. Three rows of upper-level management consoles remain and could be used as a fifth firing room. Image Credit: NASA/Dimitri Genrodidakis

near- and far-term goals of the ground systems program. Firing Room 1 has been equipped to support the launch of Exploration Mission-1 and future launches of Orion and SLS. Firing Room 4 has been transformed into a multi-use control room that will support NASA and commercial needs, while the other two firing rooms have been dismantled and await identification of requirements for their use.

Modifications continue on the mobile launcher to strengthen it to accommodate SLS' weight, size and thrust at launch. The existing 24-foot exhaust hole is being enlarged and strengthened for the larger, heavier SLS rocket.

Crawler-transporter (CT)-2 has undergone a major tune-up to enable it to carry the SLS on the Mobile Launcher to the pad. Roller bearings and roller bearing assemblies have been removed and replaced. New air conditioner

generators, electronics, cables, tubing and hydraulic components have been installed. CT-2 is now capable of carrying as much as 18 million pounds, well above the weight of the 130-metric-ton (143 ton) SLS and its payload.

The Multi-Payload Processing Facility underwent extensive upgrades and modernizations to support processing of the Orion spacecraft. The facility will be used for hypergolic fueling, ammonia servicing and high-pressure gas servicing and checkout of Orion.

The ground systems team continues to upgrade its skills, facilities and ground support equipment to safely handle a variety of rockets and spacecraft during assembly, transport and launch. The GSDO team and Kennedy are well positioned to support future vehicle processing and launch operations into the middle of this century. [SpM](#)

infrastructure needed for SLS and Orion. This review milestone shows that there are solid plans to complete these facilities and support launch."

NASA's three exploration systems development programs -- GSDO, SLS and Orion -- have been pursuing parallel development paths that keep each program progressing toward the first SLS and Orion mission. Individually, each program is making progress toward delivering its hardware in support of Exploration Mission (EM)-1 in Fiscal Year 2018.

At Kennedy, engineers and technicians have been

improving infrastructure in ways that show the progress documented in the agency-level review.

"The team has made tremendous progress improving the infrastructure at Kennedy to support SLS and Orion," said Mike Bolger, GSDO program manager. "Kennedy and its ground systems are a key component of sending humans to deep-space destinations."

The landscape at Launch Pad 39B, from where SLS and Orion will launch, has evolved over the last few years. A clean pad approach has replaced the fixed structures approach that supported space shuttle

launches. The legacy flame deflector and Apollo-era bricks from both walls of the flame trench have been removed to make way for a new flame deflector and new steel-plated walls.

Inside the massive Vehicle Assembly Building, all of the work platforms in High Bay 3 were removed, and designs are underway for 10 levels of new platforms that will surround the SLS and Orion for testing and processing. All four of the large vertical lift doors have been repaired and upgraded.

Firing rooms in the Launch Control Center have undergone extensive upgrades to meet the

The Vehicle Assembly Building and Launch Control Center are contrasted against a blue sky at Kennedy Space Center. Inside Firing Room 4, the Ground Systems Development and Operations Program is overseeing efforts to create a new firing room based on a multi-user concept. Image Credit: NASA/Dimitri Genrodidakis





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