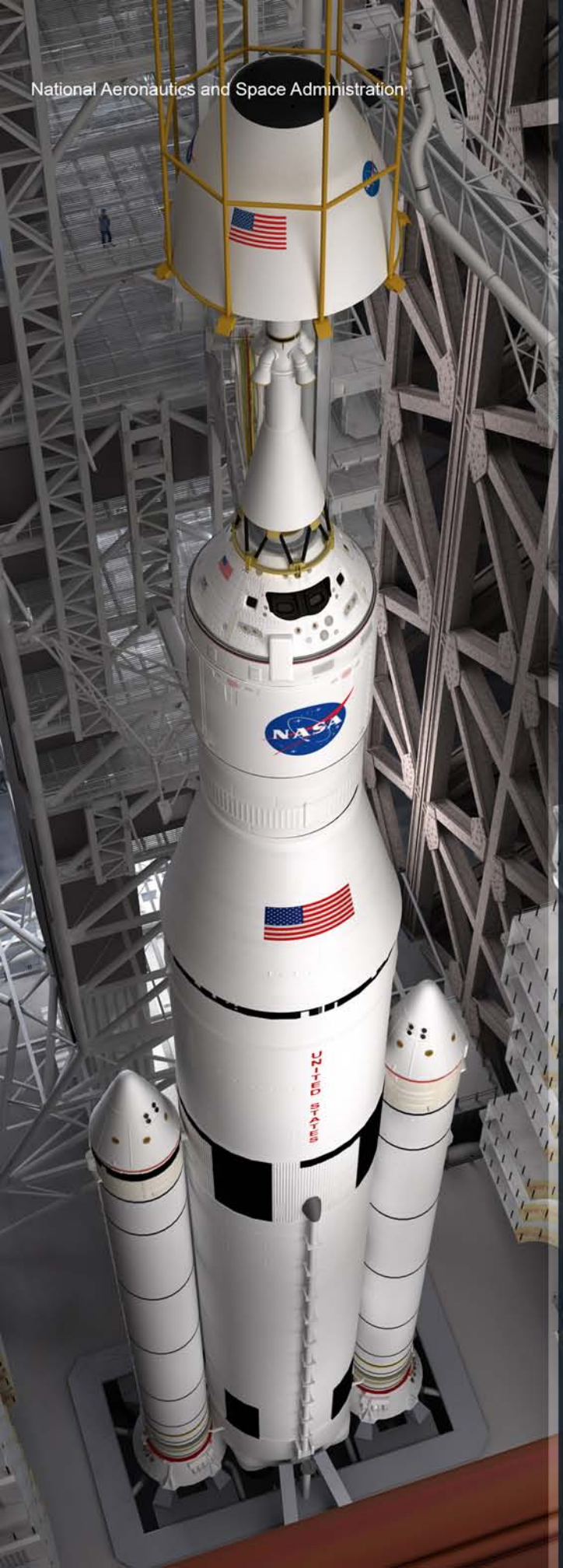

National Aeronautics and Space Administration

ESD

EXPLORATION SYSTEMS DEVELOPMENT

COMBINED MONTHLY HIGHLIGHTS

September / October 2013

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MONTHLY ACCOMPLISHMENTS
September/October 2013

orion

Orion spacecraft comes to life

NASA's first-ever deep space craft, Orion, has been powered on for the first time, marking a major milestone in the final year of preparations for flight.

Orion's avionics system was installed on the crew module and powered up for a series of systems tests at NASA's Kennedy Space Center in Florida last week. Preliminary data indicate Orion's vehicle management computer, as well as its innovative power and data distribution system - which use state-of-the-art networking capabilities - performed as expected.

Throughout the past year, custom-designed components have been arriving at Kennedy for installation on the spacecraft -- more than 66,000 parts so far. The crew module portion already has undergone testing to ensure it will withstand the extremes of the space environment. Preparation also continues on the service module and launch abort system that will be integrated next year with the Orion crew module for the flight test.

Read more about the countdown to Exploration Flight Test (EFT-1) launch at: **http://1.usa.gov/1ghqU00**

Astronauts practice launching in NASA's new Orion spacecraft

NASA Astronauts Rick Linnehan and Mike Foreman recently experienced what it will be like to launch into space aboard the new Orion spacecraft during the first ascent simulations since the space shuttles and their simulators were retired. The pair had an opportunity to try out a prototype display and control system inside an Orion spacecraft mock-up at Johnson Space Center's Space Vehicle Mock-up Facility during an Orion ascent simulation on Sept. 26.

Ascent simulations are precise rehearsals of the steps a spacecraft's crew will be responsible for — including things that could go wrong — during their climb into space. They can be generic and apply to any future deep space mission, or very specific to a launch that's been planned down to the second. For now, Orion's simulations fall into the first category, but practicing now helps ensure the team will have the systems perfected for the astronauts in any future mission scenario.

Designing a spacecraft's cockpit for ease of use and efficiency is no easy task. Each space shuttle had 10 display screens, more than 1,200 switches, dials and gauges, plus hundreds of pounds of procedures printed on paper. Orion, which is designed for deep-space exploration and autonomous or piloted rendezvous and docking, will use new technology to distill all of that down to just three computer screens, each the size of a sheet of paper.

It will take about eight minutes for Orion to get from the launch pad at Kennedy Space Center to the altitude where the rocket's main engines will cut off, the milestone that marks the spacecraft's arrival in space. In that time, if everything goes as planned, the commander and pilot will have few actions to perform; if anything goes wrong, that quickly changes, and the crew must be able to quickly access all the relevant procedures and displays they need.

Over the course of two weeks, 10 crews of two astronauts apiece performed two normal launch simulations and two launch abort simulations inside the Orion mock-up. As they made their way through the various actions they were called on to perform, engineers took careful notes of comments and question asked. That data will be evaluated as engineers continue to fine-tune the design and build requirements for the displays and controls.

Successful integration tests move Orion closer to launch

On September 25-26, NASA's Johnson Space Center's Mission Control Center (MCC) and the Lockheed Martin Exploration Development Lab successfully executed an Orion Software Integration Test. This test used the Exploration Flight Test (EFT-1) flight software version 9.2. The MCC team sent many nominal and contingency commands. Most notable is a nominal file transfer command that will be required during the flight. The team also tested several contingency commands, like switching cooling loop pumps in case of an in-flight failure. These tests and others to follow will assist in the verification of flight software loads in the MCC environment and exercise the joint NASA and Lockheed Martin flight control teams that will monitor the EFT-1 mission.

On October 22, recorded Orion telemetry was successfully transmitted between MCC-Houston and the White Sands communication facility in New Mexico. NASA's White Sands Test Facility serves as the communication hub between MCC Houston and the Tracking and Data Relay Satellite System (TDRSS) that will be used during the EFT-1 flight to receive and retransmit the Orion spacecraft telemetry. This is the first time that Orion-formatted data has been sent via this link. This test paves the way for future tests that will have Orion spacecraft telemetry and commands flow between the vehicle at Kennedy Space Center, White Sands, TDRSS, and MCC-Houston.

Honeywell completes deliveries for Orion EFT-1 flight

With the acceptance of the second Orion Inertial Measurement Unit (OIMU), Honeywell Aerospace has successfully completed all of its deliveries for the Exploration Flight Test (EFT)-1.

Designed and manufactured in Clearwater, Fla., the OIMU provides the inertial measurement data to the vehicle's guidance and navigation system. This information, augmented by data from the GPS receiver, is used to determine the spacecraft's precise location in space.

The OIMU is a critical component in the guidance and navigation control of the vehicle that will be used throughout all of the mission phases. The OIMU's electronics, including the gyro electronics, are hardened against radiation and designed to survive the radiation levels expected in the mission environment.

In addition to the OIMU and the spacecraft's avionics, Honeywell's contributions to the Orion program include the power data unit cards, network interface cards, GPS receiver, vehicle management computer and barometric altimeter.

Orion hardware ready for pressure testing

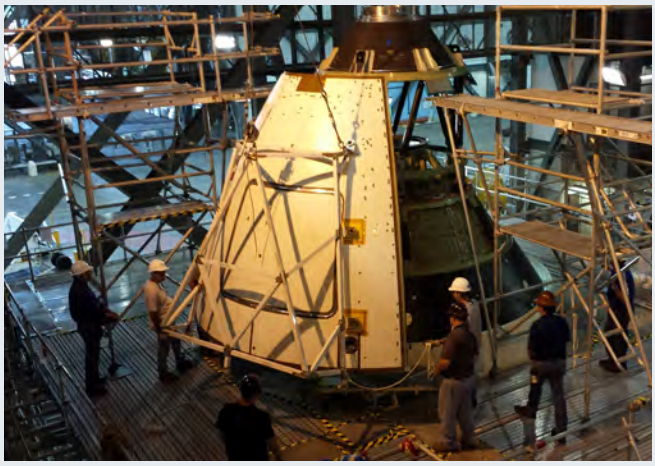
The design and fabrication of critical flight hardware that will be used to keep NASA's Orion spacecraft safe during launch was recently completed at Janicki Industries in Hamilton, Wash. The hardware arrived at NASA's Marshall Space Flight Center in Huntsville, Ala., for final preparations before Orion's first mission, planned for September 2014.

Orion's stage adapter diaphragm serves as a barrier between the upper-stage of the launch vehicle and the spacecraft, preventing hydrogen gas build up from the rocket beneath the spacecraft before and during launch.

The diaphragm, a light-weight composite structure, was designed by a team of engineers at NASA's Langley Research Center in Hampton, Va., in close collaboration with Marshall. The component is an integral part of the stage adapter that will connect Orion to a Delta IV Heavy rocket during its first mission, Exploration Flight Test-1, and on the first launch of NASA's Space Launch System in 2017.

The diaphragm will undergo pressurized testing at Marshall to certify it for flight conditions before being integrated with the spacecraft's stage adapter.

To learn more about Orion's stage adapter diaphragm, visit: **http://tinyurl.com/ke2qayr**



Pathfinding operations ongoing for Orion

At NASA's Kennedy Space Center in Florida, the Orion ground test article (GTA) was moved by crane and stacked on top of the service module mock-up in the Vehicle Assembly Building. The GTA is being used for pathfinding operations, including simulated manufacturing, assembly and stacking procedures, and to validate the scaffolding and lift procedures for installation of the launch abort system (LAS) ogive panels. The test is supported by the ground systems contractor with support from Lockheed Martin and NASA Orion personnel, and uses the GTA crew module, LAS GTA motor adapter truss assembly and GTA ogive panels.

Exploration Design Challenge registers more than 100,000 students

The Exploration Design Challenge has more than 100,000 students from 50 states and 70 countries registered to take the challenge.

NASA, in collaboration with Lockheed Martin and the National Institute of Aerospace, launched the NASA Exploration Design Challenge (EDC) in March 2013 to promote STEM engagement activities tied to the EFT-1.

Students in grades K-12 will research and design ways to protect astronauts from deep space radiation. Students in grades 9-12 can take the challenge a step further and design a radiation shield with one winning experiment design to be built and flown on EFT-1. The winning team will be flown to Kennedy Space Center to watch their payload launch into space aboard the Orion spacecraft. The names of all participating K-12 students who complete a radiation shielding challenge will be flown on EFT-1, making them the official "virtual crew" members for this mission.

Students can register for the challenge at:
www.nasa.gov/education/edc

Ukrainan Vice Prime Minister for Ecology, Natural Resources, Energy and Space Yuriy Boyko took time to visit the Orion mock-up at Johnson Space Center's Space Vehicle Mock-up Facility on Oct. 29 during a tour of JSC. Orion's John Casper presented an overview of the Orion Program to the dignitary and his entourage during the tour.

Exploration Systems Development has a new quarterly video "Building Momentum" which is featured on the NASA/Orion home page. Watch it here: **http://bit.ly/16pVAXb**

Orion heat shield presented in Boston

Orion subcontractor Textron Defense Systems (TDS) participated in the Boston Museum of Science's "Mars & Beyond" event from Aug. 31 to Sept. 1 to share information about the exciting work they are doing on the Orion spacecraft heat shield. The display focused on Orion and TDS' legacy with Avcoat/Apollo. Textron's Samantha Zaruba gave a presentation at the museum on the heat shield.

Uniting science and art

Orion launch abort system engineer Leslie Wood recently received national attention for her artwork, which combines art and science. Read more about Leslie at: **http://bit.ly/1aPeVCM**

I am building Orion

Read about Astronaut Nicole Stott at: **http://on.fb.me/17fj8Pg**

Orion engineer receives 2013 Great Minds in STEM award

Dan Baca, systems engineer on the Orion program at Lockheed Martin Space Systems' Waterton facility near Denver, is the recipient of the 2013 Great Minds in STEM Most Promising Engineer with an Advanced Degree award.

The award program seeks to recognize the achievements of the nation's top engineers and scientists within the Hispanic community. Award recipients distinguish themselves through professional and academic accomplishments, as well as contributions to STEM and community outreach.

Baca received his award from Rick Ambrose, executive vice president, Lockheed Martin Space Systems Company, during the 25th annual Hispanic Engineer National Achievement Award Corporation (HENAAC) Conference, Oct. 3-5 in New Orleans.

Photo: Lockheed Martin

National Aeronautics and
Space Administration

Space Launch System
Highlights

September/October 2013

RS-25: Still the Biggest, Baddest Engine Around

Artist rendering of the RS-25 engines powering the liftoff of the SLS from the pad. *(NASA)*

Four RS-25 engines, like the one pictured at left undergoing a hot-fire test, will power the core stage of the SLS. The RS-25, also known as the space shuttle main engine, is the first reusable rocket engine in history. "During the 30-year run of the Space Shuttle Program, the RS-25 achieved very high demonstrated reliability," said Garry Lyles, chief engineer for the Space Launch System Program Office at NASA's Marshall Space Flight Center in Huntsville, Ala. "And during 135 missions and numerous related engine tests, it accumulated over 1 million seconds—or almost 280 hours—of hot-fire experience. With that kind of reliability, we knew it would be the best engine to power SLS." For the full story on the RS-25 engine, **click here**. *(Aerojet Rocketdyne)*

Spaceflight Partners: AMRO Fabricating Corp.

EDITOR'S NOTE: Every month, SLS Highlights turns the spotlight on one of the industry partners helping to create the largest rocket ever built for human space exploration. In this issue, we profile AMRO Fabricating Corp. in South El Monte, Calif.

An AMRO Fabricating Corp. employee stands on a barrel panel for the SLS. Headquartered in South El Monte, Calif., AMRO specializes in the manufacturing of lightweight, metallic structures for demanding environments on missiles, launch vehicles and spacecraft. In support of Boeing core stage manufacturing for the SLS, AMRO produces engine section barrel panels, liquid hydrogen (LH2) barrel panels, intertank barrel panels, liquid oxygen (LOX) barrel panels, forward skirt panels and tooling. Founded in 1977, AMRO is a small, woman-owned business with about 250 employees. *(AMRO)*

NASA Continues Preparation for SLS Engine Testing at Stennis

NASA engineers and contractors recently completed liftoff transition testing of a 67.5-inch model of the SLS in a 14-by-22-foot subsonic wind tunnel at NASA's Langley Research Center. Data acquired from the test will help prepare SLS for its first mission. For the full story on the testing, and to watch a video, **click here**. *(NASA/Langley)*

During the liftoff transition testing of a nearly 6-foot model of the SLS, engineers used a technique for studying airflow streamlines called smoke flow visualization, giving them insight into the data retrieved. Smoke is put into the wind flow and can be seen during testing. This allows engineers to see how the wind flow hits the surface of the model. *(NASA/Langley)*

Adapter Diaphragm Delivered to Marshall Space Flight Center

At right, engineers at the Marshall Center unwrap the adapter diaphragm Sept. 27. The diaphragm will undergo pressurized testing at Marshall before being integrated with the spacecraft's stage adapter—certifying it for flight conditions. *(NASA/MSFC)*

At left, the Orion's stage adapter diaphragm leaves a manufacturing facility at Janicki Industries in Hamilton, Wash., to be trucked to NASA's Marshall Space Flight Center. The diaphragm will be used to keep launch vehicle gases away from the Orion spacecraft. It was designed by a team of engineers at NASA's Langley Research Center, in close collaboration with Marshall. For the full story on the delivery and what's next for the diaphragm, **click here**. *(Janicki Industries)*

SLS On the Road…

SLS Assistant Program Manager Sharon Cobb talks to students Sept. 10 at San Diego State University about NASA's new rocket and the importance of science, technology, engineering and mathematics in fulfilling the agency's goals. Cobb was in San Diego for the AIAA Space2013 conference —an event focused on critical issues for the space industry. *(NASA/MSFC)*

Todd May, SLS Program Manager, at a podium on board the USS Alabama in Mobile, talks to the public about the SLS, NASA's "Next Great Ship," Sept. 4. NASA astronaut Tony Antonelli also was on deck to sign autographs. *(NASA/Michoud)*

While in the Mobile area, May—who grew up in nearby Fairhope—spoke about the SLS Program to students at his alma mater, Fairhope High School, on Sept. 5. *(NASA/MSFC)*

More than 300 people visited the SLS exhibit Sept. 15 at TEDx-Huntsville 2013, held at Randolph High School in Huntsville. NASA prime contractor Boeing was the principal sponsor of the event. *(NASA/MSFC)*

For more SLS news, updates and resources, visit www.nasa.gov/sls

Follow SLS on:

SLS on Deck:

- Algorithm testing on F/A-18 at Dryden
- EFT-1 diaphragm proof test
- KDP-C
- Acoustic testing

National Aeronautics and Space Administration

GSDO GROUND SYSTEMS DEVELOPMENT & OPERATIONS

EXPLORATION BEGINS HERE

PROGRAM HIGHLIGHTS • SEPT/OCT 2013

At NASA's Kennedy Space Center in Florida, the Ground Systems Development and Operations (GSDO) Program Office is leading the center's transformation from a historically government-only launch complex to a spaceport bustling with activity involving government and commercial vehicles alike. GSDO is tasked with developing and using the complex equipment required to safely handle a variety of rockets and spacecraft during assembly, transport and launch. For more information about GSDO accomplishments happening around the center, visit http://go.nasa.gov/groundsystems.

Mike Bolger Named GSDO Program Manager

Mike Bolger recently was named director of the Ground Systems Development and Operations (GSDO) Program at Kennedy Space Center. He had served as acting manager of the GSDO Program since April 2013.

Bolger is responsible for leading the government and contractor team that is preparing the ground systems, infrastructure, facilities and processes required to support NASA's next-generation space launch systems and spacecraft.

"We are charged with modernizing the launch infrastructure of the Kennedy Space Center and upgrading our ground systems to support the Space Launch System (SLS) launch vehicle and the Orion spacecraft," Bolger said. "Kennedy will be a modern multi-use spaceport. It's an exciting mission and I'm proud to lead the great team that is going to make it happen. Exploration starts here!"

Bolger began his career in 1987 as a software engineer supporting space shuttle processing at Kennedy. He later managed a project controls office and acted as the contracting officer's technical representative for the Joint Base Operations Support Contract. In 2006, he was named the chief information officer and most recently spent eight months as the acting deputy director of the center.

Bolger was born in Bellefonte, Pa., and grew up in Oxford, Ohio. He graduated from Indiana University in 1987 with a bachelor's in computer science and a minor in mathematics. He earned a master's in business administration from the University of Central Florida in 1999.

Bolger lives in Merritt Island with his wife, Samantha, and their three children.

Ground support equipment technicians prepare one of the jacking, equalizing and leveling, or JEL, hydraulic cylinders for removal from crawler-transporter 1 at the crawler transporter maintenance facility Oct. 22. New JEL hydraulic cylinders will be installed on CT-1 to test their increased load-carrying capacity and reliability.

Pad 39B Flame Deflector will Support a Variety of Launch Vehicles

Significant changes are happening at Launch Pad 39B at NASA's Kennedy Space Center in Florida as the Ground Systems Development and Operations (GSDO) Program prepares it to support the launch of a variety of vehicles, including NASA's Space Launch System (SLS).

A stark, gaping space can be seen between the walls of the pad's flame trench. Construction workers have completely removed the massive flame deflector structure that served to protect the pad and space shuttles during 30 years of launches from the site.

Jose Perez Morales, the GSDO Pad Element project manager, said there will be substantial changes in the design of the new flame deflector.

"We have achieved a 30-percent design review and are now moving toward a 60-percent design review," Perez Morales said. "The flame deflector is going to look very different."

With the help of NASA's Ames Research Center at Moffett Field, Calif., GSDO engineers ran computational fluid dynamic simulations of engine launches of five existing launch vehicles and discovered that the exhaust could be redirected to only the north side of the flame deflector.

Perez Morales said the new flame deflector will be positioned about six feet south of the old flame deflector's position to accommodate the design of the new mobile launcher.

The bricks on both sides of the trench walls, dating back to Apollo days, are being removed to make way for new heat-resistant bricks. The north walls of the flame trench will be covered in bricks and Fondu Fyre, while the south side concrete walls will be left bare.

Construction workers use machinery to remove Apollo-era bricks and Fondu Fyre from the flame trench walls at Launch Pad 39B.

Construction of the new flame deflector and renovation of the flame trench walls are scheduled to begin in January 2015.

For the complete story, visit http://go.nasa.gov/1h6y74k

A technician completes the installation of a new bearing on crawler-transporter 2 in Vehicle Assembly Building high bay 2, Sept. 10. Modifications underway on the crawler are designed to ensure its ability to transport launch vehicles currently under development, such as NASA's Space Launch System, to the launch pad. GSDO is overseeing the upgrades.

During the 2013 KSC Innovation Expo, GSDO supported three showcases in several facilities to demonstrate and communicate the exciting work that is being done here at the center.

Employee Spotlight - John Rigney

John Rigney is the lead architect for the Ground Systems Development and Operations Program (GSDO) at Kennedy Space Center. He is responsible for leading architecture and operations trade studies for NASA's Space Launch System, Orion, GSDO and commercial users.

Rigney recently received the Catalyst Award from the Center Planning and Development (CPD) Office.

"It is a great honor to receive such a prestigious award for doing work that I truly enjoy and is so vital to KSC," Rigney said.

The Catalyst Award is given to members of the Kennedy workforce who have made significant contributions to the vitality of the space industry at the center. Award recipients are distinguished as having pioneered new approaches that enable the center to support the development of successful and viable commercial space endeavors.

"We would like to express our deep appreciation to John for his support of the CPD team, and his efforts to bring new commercial launch business opportunities to Kennedy Space Center," said Scott Colloredo, CPD director.

Rigney began his career at Kennedy in 1983 working for a contractor. One of his favorite memories is working on ground systems integration during the Space Shuttle Program.

His first car was a white 1970 Ford Maverick. If he hadn't worked at Kennedy he would have pursued a career as a veterinarian. His hobbies are golf, college football and traveling. He is married to wife Betsy, and they have one daughter, Morgan, and one son, Johnny.

John Rigney recently received the Catalyst Award from the Center Planning and Development Office. Presenting him with the award is Vicki Johnston, manager of the Partnership Development Office.

Technicians monitor the progress as the Orion ground test vehicle was lifted high in the air by crane in the transfer aisle of the Vehicle Assembly Building on Oct. 22, and lowered toward a mockup of the service module in high bay 4. The ground test vehicle is being used for pathfinding operations, including simulated manufacturing, assembly and stacking procedures.

On Sept. 19, crawler-transporter 1 (CT-1) successfully rolled out from Vehicle Assembly Building high bay 3 to the crawler-transporter yard so that installation of the two jacking, equalization and leveling (JEL) qualifications units could begin. After installation, CT-1 will roll out to the Launch Pad 39A slope to ensure that the JEL cylinders fit within the CT structure. After a successful test, full production of JEL cylinders will begin. CT-1 will be available for a variety of launch vehicles.

National Aeronautics and Space Administration