

EXPLORATION SYSTEMS DEVELOPMENT

COMBINED MONTHLY REPORT
January–February 2019

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Ascent Abort-2 Test**

SLS:
**Getting Ready for the
Core Stage**

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Prepping for a Swing Test






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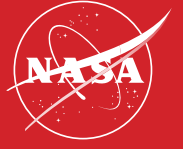
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ORION



FEBRUARY 2019



Save the Date

Launch Date Set for Ascent Abort-2 Flight Test

SAVE THE DATE



The Orion program has officially set the date for the Ascent Abort-2 (AA-2) flight test for June 12, 2019. During the months of January and February, the team integrated the three motors of the Launch Abort System (LAS), started work on the Abort Test Booster (ATB) guidance and control assembly, and has begun work integrating the ATB itself, as well as the crew module and separation ring, all at NASA's Kennedy Space Center in Florida. At the launch pad where AA-2 will be tested, Space Florida also completed integration of lightning towers, which will keep the hardware out of danger in case of nearby lightning strikes while on the pad.

AA-2 will involve a full-scale test of the LAS under the most demanding ascent conditions astronauts would encounter

inside Orion. After being lifted off the ground by the ATB, the crew module, sized and weighted to represent Orion, will undergo an abort sequence initiated at 31,000 feet, 55 seconds after launch. At that time, the abort motor will fire and the LAS will pull the crew module away from the ATB, relying on attitude control motors to reorient the LAS a safe distance away. Once reoriented, the jettison motor will fire, separating the LAS from the crew module, which will return to the ocean and simulate a safe return for future astronauts. This test will verify that the LAS can steer Orion and its crew inside to safety in the event of an unlikely issue with the Space Launch System rocket when the spacecraft is under the highest aerodynamic loads it will experience during a rapid ascent into space.

POWERED ON, READY TO GO

At NASA's Kennedy Space Center Operations & Checkout (O&C) building, the Orion Exploration Mission (EM)-1 European Service Module has been successfully powered on. After arriving only three months prior, in November, the initial power on resulted in no issues as the power conditioning distribution unit, which maintains constant voltage to prevent electrical malfunctions in the spacecraft,

was successfully tested. The initial power on marks the beginning of testing the Orion team will perform to identify potential electrical malfunctions or parts that are not responding correctly so they can be repaired or replaced before integration with the crew module. Assembly, integration and testing also continue on EM-1 and EM-2 crew modules in the O&C.

TEXAS SPACE DAY

NASA and aerospace industry partners visited the Texas State Capitol on February 26 for Space Day, an annual event highlighting achievements in human space exploration throughout the state of Texas. The schedule of events and exhibits in Austin that day focused on STEM education, exploration, and astronauts.

NASA's Johnson Space Center took over the Capitol ground-floor rotunda to share its accomplishments including Orion and preparations for the Ascent Abort-2 test. Orion team members staffed exhibits and met with state congressional representatives to share information about the program and the impact that Texas companies have on deep space exploration. NASA's workforce in Texas includes more than 11,000 aerospace employees and more than \$2 billion in contracts and federal salaries in 2018.



7TH ANNUAL SUPPLIERS CONFERENCE

The 7th Annual Orion/Space Launch System (SLS)/ Exploration Ground Systems (EGS) Suppliers' Conference was held in Washington D.C., from February 13–14. More than 2,400 companies have contributed to the Orion program since its inception, of which almost half are small businesses, and hail from all 50 states, Puerto Rico and Washington D.C. With so many in attendance, the conference itself is a testament to the impact the Orion program is having on America, not only by inspiring the next generation with space travel, but by creating employment for more people, and providing opportunities for businesses large and small to grow and expand. For some small

businesses, having a contract to work on the Orion program has led to other opportunities in other business sectors they may not have been granted otherwise.

The conference included talks led by NASA management, with subjects ranging from lunar science, information about the Moon to Mars campaign, Center updates, and Deep Space Exploration. Updates were also given on Orion/SLS/EGS progress by an industry panel, as well as budgeting and policy changes.

Learn more: solorionsuppliers.com/



SUPPLIER SPOTLIGHT

STELLAR SOLUTIONS



Stellar Solutions is a woman-owned, global aerospace systems company headquartered in Silicon Valley. Stellar Solutions provides test engineering for Orion's avionics interface, specifically contributing to the guidance, navigation, and control systems, the propulsion systems, and the Launch Abort System. In addition, Stellar Solutions has verified that Orion's flight software meets NASA's design requirements ensuring it will keep astronauts safe during deep space missions. They have also assisted in creating

data and sequencing controls for all of Orion's autonomous events, as well as automated the post processing for the environmental control and life support system. While Stellar Solutions has contributed to other NASA programs such as Solar Orbiter, Landsat, and New Horizons, their work on the Orion program is the first time the company has assisted with a crewed mission.

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NASA'S NEW SPACECRAFT
FOR HUMAN EXPLORATION:

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HOUSTON WE HAVE A PODCAST: **LIVABLE SPACE**

In episode 79, John Lewis, Orion Environmental Control and Life Support system manager discusses how the Orion spacecraft will keep the crew inside comfortable —and more importantly alive—during a mission into deep space.

Listen here: go.nasa.gov/2VCqTLM



SPACE LAUNCH SYSTEM

JANUARY–FEBRUARY 2019

GETTING READY FOR THE CORE STAGE





The liquid hydrogen tank has completed thermal protection application and will be mated to other parts of the core stage that will fly on Exploration Mission-1.

Technicians at NASA's [Michoud Assembly Facility](#) in New Orleans completed application of the [thermal protection system](#) on the 130-foot-long liquid hydrogen (LH2) tank for [NASA's Space Launch System](#) rocket.

The LH2 tank is the largest piece of flight hardware to ever be insulated at Michoud. The hardware requires thermal protection due to extreme temperatures it will face during launch and to keep the liquid hydrogen at minus 423 degrees Fahrenheit during the flight to space. Now the tank is being prepared for joining with other major structures to form the rocket's massive [212-foot core stage](#), which serves at the backbone of SLS.

The core stage includes the liquid hydrogen and liquid oxygen tanks, which hold 733,000 gallons of propellant to power the stage's four RS-25 engines. The engines will produce 2 million pounds of thrust to help send the rocket to orbit for Exploration Mission-1, the first flight of SLS and the Orion spacecraft that will travel beyond the Moon.

The world's most powerful rocket, SLS will send astronauts on deep space missions farther than humans have ever traveled before.

Learn more about the SLS core stage here: [go.nasa.gov/2TmoNie](https://www.nasa.gov/2TmoNie)

NASA AND GUESTS CELEBRATE CORE STAGE INTEGRATION



NASA staff, media, and elected officials gathered February 28 to celebrate the SLS rocket's [forward join](#), which marks the beginning of integration and assembly of the rocket's core stage. The forward join effectively connects three major structures — the forward skirt, the liquid oxygen tank and the intertank—to form the top part of the core stage. When complete, the core stage will stand 212 feet tall and include four RS-25 rocket engines, propellant tanks, and flight computers.

Learn more about how the rocket's core stage comes together here: bit.ly/2TAa9XT

ASTRONAUTS AT ENGINE TEST

The ninth and final test in a series evaluating next-generation parts for [SLS](#) engines was successfully completed February 28.

The 500-second hot fire, conducted at NASA's Stennis Space Center in Mississippi, pushed the RS-25 developmental engine No. 0525 to 113 percent of its original thrust design for a record 430 seconds, about four times longer than any previous hot fire at that level. It was the fourth time the engine has been pushed to 113 percent.

The test series, which began last August, evaluated new components made with innovative manufacturing techniques that save time and money.

Read the full story: go.nasa.gov/2EqK581



Astronauts Randy Bresnik and Stan Love gave live updates during a Feb. 28 RS-25 engine test at Stennis Space Center.

WHAT'S NEW IN SLS SOCIAL MEDIA

ROCKET SCIENCE IN 60 SECONDS



The SLS core stage, the largest piece of the rocket, consists of five main structures totaling more than 200 feet in height. Chad Bryant, core stage manager for SLS, explains how the pieces come together to form the world's most powerful rocket.

Watch the latest Rocket Science video here: bit.ly/2UrgPVq

SLS ON THE ROAD

MEDIA AND ELECTED OFFICIALS VIEW SLS PROGRESS



New Orleans Mayor LaToya Cantrell (top right) talks with Kevin McGhaw (top left), Deputy Director of Marshall Space Flight Center's Office of Strategic Analysis and Communications, and Steve Miley, Associate Director of Marshall Space Flight Center, during an SLS milestone event at Michoud Assembly Facility in New Orleans February 28. Media and area elected officials visited Michoud to view progress on the SLS core stage, and watched an RS-25 engine test at Stennis Space Center in south Mississippi.



I AM BUILDING SLS: MICHELLE GONZALEZ

Space has been a part of Michelle Gonzalez's life as long as she can remember. She grew up close to NASA's [Kennedy Space Center](#) in Florida and remembers running outside to see the space shuttle launches and thinking that one day she wanted to be a part of the action.

Today, Gonzalez works as the Northrop Grumman program manager for the booster avionics and flight safety system for NASA's new rocket, the [Space Launch System](#). Her team is working to ensure [booster avionics](#) hardware is ready for EM-1, the first flight of SLS and Orion.

Read the full story: go.nasa.gov/2NxXdfL

SPACEFLIGHT PARTNERS: *Canvas, Inc.*

NUMBER OF EMPLOYEES: 100

LOCATION: *Huntsville, AL.*

WHAT THEY DO FOR SLS:

Canvas, Inc., is a woman-owned small business responsible for the Launch Vehicle Stage Adapter (LVSA) end item specifications, operational requirements, and verification work for SLS flight readiness reviews.



FOLLOW THE PROGRESS OF NASA'S NEW LAUNCH VEHICLE FOR DEEP SPACE:

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COMING NEXT MONTH:

Testing RS-25 engine controllers

Exploration upper stage engine testing



EXPLORATION GROUND SYSTEMS

H I G H L I G H T S

FEBRUARY 2019

A large, complex industrial structure, likely the Common Service Interface Test Unit (CSITU), is shown in a factory setting. The structure is made of metal beams and supports, with various pipes and cables. A large orange cylindrical component is visible in the center. The background shows a high ceiling with a grid of lights and other industrial equipment.

**CSITU
Prepped for
Swing Arm Test**

EGS MONTHLY HIGHLIGHTS



CSITU Swing Arm Preps



Upgrades Continue at Launch Complex 39B



Work Begins on Liquid Hydrogen Tank



EM-1 Countdown Rehearsal Completed



CSITU SWING ARM PREPS

Preparations are underway to perform a preliminary swing test of the Core Stage Inter-Tank Umbilical (CSITU) on the mobile launcher in High Bay 3 of the Vehicle Assembly Building on February 22, 2019, at NASA's Kennedy Space Center in Florida. The CSITU is a swing-arm umbilical that will connect to the Space Launch System core stage inter-tank. It will provide conditioned air, pressurized gases, and power and data connection to the core stage. The Ground Systems Development and Operations Program is overseeing installation of the umbilicals. Photo credit: NASA/Frank Michaux

Preparations were underway to perform a preliminary swing test of the Core Stage Inter-Tank Umbilical (CSITU) on the mobile launcher in High Bay 3 of the Vehicle Assembly Building on February 22, 2019, at NASA's Kennedy Space Center in Florida.

UPGRADES CONTINUE AT LAUNCH COMPLEX 39B



A construction worker welds a section of metal on the surface of Launch Pad 39B at NASA's Kennedy Space Center in Florida on February 22, 2019.

A construction worker welds a section of metal on the surface of Launch Pad 39B at NASA's Kennedy Space Center in Florida on February 22, 2019. The launch pad has undergone upgrades and modifications to accommodate NASA's Space Launch System and Orion spacecraft for Exploration Mission-1 and subsequent missions. Upgrades include new heat-resistant bricks on the walls of the flame trench and installation of a new flame deflector. All of the upgrades have been managed by Exploration Ground Systems. Photo credit: NASA/ Kim Shiflett

INNOVATIVE LIQUID HYDROGEN STORAGE TO SUPPORT SPACE LAUNCH SYSTEM



Agency and contractor managers break ground for a new liquid hydrogen tank on December 19, 2018, at Launch Complex 39B at NASA Kennedy Space Center. The storage facility will hold 1.25 million gallons of the propellant for NASA's Space Launch System rocket designed to boost the agency's Orion spacecraft, sending humans to distant destinations such as the Moon and Mars. Photo credit: NASA/Kim Shiflett



Construction workers stage parts and equipment for a new liquid hydrogen storage tank nearby Launch Pad 39B at NASA's Kennedy Space Center on February 22, 2019. The tank will support fueling of the agency's Space Launch System rocket. Photo credit: NASA/Kim Shiflett

As NASA continues preparations for the first launch of its [Space Launch System](#) (SLS) rocket and [Orion](#) spacecraft that will send humans beyond low-Earth orbit, [Exploration Ground Systems](#) (EGS) at the Agency's Kennedy Space Center in Florida is preparing to build the world's largest liquid hydrogen storage tank. It will involve new technologies developed by researchers at the spaceport's [Cryogenics Test Laboratory](#).

The innovation is like going from an ice box to a modern refrigerator.

To support fueling of NASA's SLS rocket, Kennedy's EGS Program soon will begin construction of the new liquid hydrogen storage tank at Pad 39B. The SLS rocket is designed to launch the Agency's Orion spacecraft, sending humans to distant destinations, such as the Moon and Mars. The [SLS core stage](#) and [in-space stage](#) will require 730,000 gallons of liquid hydrogen and liquid oxygen to fuel the four core stage and single upper stage engine. "The larger tank will allow us to attempt SLS launches on three consecutive days," Fesmire said. "In the past, we had to stand down after two attempts so additional liquid hydrogen could be trucked in and loaded into the storage tank."

Since 2001, Dr. Bill Notardonato, a principal investigator in Kennedy's Exploration Research and Technology Programs, and Dr. Jong Baik, of the Florida Solar Energy Center, have been working at the center's Cryogenics Test Laboratory pioneering a technology to mitigate these losses. Read the full story at <https://go.nasa.gov/2Co3qHq>.



An overall view of Firing Room 1 at the Kennedy Space Center's Launch Control Center shows the launch team at work during a terminal countdown demonstration for Exploration Mission-1 (EM-1). Taking place on December 14, 2018, the countdown demonstration was intended to validate the launch team's capability to perform an EM-1 countdown and respond to challenges put into the system for practice. Photo credit: NASA/Kim Shiflett

KENNEDY LAUNCH TEAM PERFORMS EM-1 COUNTDOWN REHEARSAL

A rehearsal can ensure everyone and everything is ready for a big performance. In the business of launching rockets, NASA and contractor engineers and managers at NASA's Kennedy Space Center in Florida recently performed the first terminal countdown demonstration for the inaugural flight of the agency's Space Launch System (SLS) rocket and Orion spacecraft.

When sending humans into space, "practice makes perfect" is taken literally by the Exploration Ground Systems (EGS) team.

As Launch Director, NASA's Charlie Blackwell-Thompson leads the EGS team of SLS and Orion experts performing the demonstration and she was eager to begin.

"I can't wait to see what today holds," she said addressing those in [Firing Room 1](#) of Kennedy's Launch Control Center (LCC). "I look forward to seeing what the simulation team has in store. With that, NTD (NASA Test Director), you've got a go to proceed."

Taking place on December 14, the demonstration was intended to validate the launch team's capability to perform an EM-1 countdown and respond to problems put into the system for practice.

"This demonstration was designed to give the launch team an understanding of what to expect with a new vehicle," said Blackwell-Thompson. "This also will help us gauge where we are as a team in our preparations for future simulations and the upcoming EM-1 mission."

The first integrated test of the new vehicles will be EM-1 – Exploration Mission 1, a key step in NASA's deep space exploration program designed to send humans to distant destinations, such as the Moon and Mars.

While there was no SLS at Kennedy's Launch Complex 39B for the recent demonstration, software called an "emulator" provided launch controllers with a virtual experience of what would be happening with the rocket. Video monitors depicted a realistic image of the SLS and Orion at Pad 39B.

"We had the full launch team of 91 experts, test conductors, engineers and managers, at their consoles in the Firing Room for the demonstration," Blackwell-Thompson said. "It's a smaller group than in the past, but we're striving for efficiency."

Read the full story at <https://go.nasa.gov/2Y8GHbd>.



Exploration Ground Systems created a new patch desktop image.

National Aeronautics and Space Administration

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