EXPLORATION SYSTEMS DEVELOPMENT

COMBINED MONTHLY REPORT
February 2018

Orion: A Promising Future

SLS: The Intertank Journeys to Alabama

EGS: Crew Access Arm Installed on Mobile Launcher
## ORION

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A Promising Future for Orion

A PROMISING FUTURE FOR ORION

On February 12, at NASA’s Marshall Space Flight Center in Huntsville, AL, Acting NASA Administrator Robert Lightfoot shared insight on the fiscal year 2019 budget proposal for the Agency. The administration’s confidence in NASA leadership points to America leading the way back to the Moon, and on to Mars.

While the budget has not been finalized, the current proposal focuses NASA on its core exploration mission. Reinforcing emphasis on human space flight and deep space exploration will increase NASA’s ability to return value to the U.S.

By continuing funding and focus on Orion, the Space Launch System (SLS), and Exploration Ground Systems (EGS), NASA is strengthening the Nation’s economy by relying on support of small businesses and contractors who are responsible for different parts of each component. This centering also strengthens relations with other nations, such as the partnership between ESA (European Space Agency) and NASA on the European Service Module, crucial for mission success and astronaut safety on Orion.

With the administration’s support, NASA’s ability to provide solutions to tough problems and inspire the next generation places the U.S. once again in the forefront of leading humanity’s future in space. It also points to America’s ability to lead the efforts in aeronautical breakthroughs and cutting-edge sciences crucial to surviving beyond our own atmosphere. Developing technology to explore deep space enables discoveries to be made that increase the knowledge and technology used on Earth.

While Orion, SLS, and EGS are once again primary focuses for NASA’s future, the budget also points to strengthening commercial crew for low-Earth orbit and robotics exploration to the Moon, Mars and other planets beyond.

With NASA’s funding and the president’s Space Policy Directive-1, which charges NASA to lead exploration back to the Moon and on to Mars, things are looking good for Orion, SLS, and EGS on their journey towards Exploration Mission-1.

As part of the budget proposal, NASA and partners are planning to build the Lunar Orbital Platform-Gateway in the 2020s. The gateway will provide the foundation for human exploration deeper into the solar system, drive our activity with commercial and international partners and help us explore the Moon and its resources, according to William Gerstenmaier, associate administrator, Human Exploration and Operations Mission Directorate, at NASA Headquarters in Washington. “We will ultimately translate that experience toward human missions to Mars,” he said.

See Lightfoot’s remarks: go.nasa.gov/2oKEL8y
ORION PASSES THERMAL CYCLE TESTING

When NASA’s Orion spacecraft launches into space atop the agency’s Space Launch System rocket on its first uncrewed integrated flight, Exploration Mission-1 (EM-1), it will travel thousands of miles beyond the Moon and return to Earth for splashdown in the Pacific Ocean. While traveling to deep space, Orion will experience extreme hot and cold temperatures, with re-entry temperatures nearing 5,000 degrees Fahrenheit.

Before Orion is exposed to the harsh conditions of launch, deep space and re-entry, it is being prepared and tested inside the Neil Armstrong Operations and Checkout Building high bay at NASA’s Kennedy Space Center in Florida. The Orion Program successfully completed a thermal cycle test on the Orion crew module inside a specially constructed thermal cycle chamber in the airlock of the high bay. Over the next five days, the crew module was rapidly cycled between hot and cold temperatures to thermally stress the hardware and ensure the workmanship of the crew module’s critical hardware and its subsystem operations. The cycle of temperatures for the initial thermal test ranged from 29 to 129 degrees Fahrenheit during 105 hours of testing.

NASA and Lockheed Martin engineers in three different areas conducted and monitored the test, including the team in the high bay near the chamber controls, the ground test instrumentation readout area, and the Test and Launch Control Center, where system managers powered on and monitored the crew module’s subsystems.

A thermal cycle test of Orion’s integrated crew and service module, along with electromagnetic interference and compatibility testing, is scheduled for early next year at NASA Glenn’s Plum Brook Station in Sandusky, Ohio. While testing at Kennedy helps ensure Orion is ready for EM-1, Plum Brook facilities can simulate more extreme conditions and will help validate the integrated spacecraft design for future missions. The service module is the powerhouse of the spacecraft, providing it with the electricity, propulsion, thermal control, air and water it will need in space.

During EM-1, the Orion crew module structure will reach temperatures ranging from minus 300 degrees Fahrenheit to plus 250 degrees Fahrenheit depending on the Sun’s angle on its way to the Moon.
Technicians at NASA’s Langley Research Center in Hampton, VA, have been building the Orion crew module structure for the Ascent Abort Test-2 (AA-2), modifying a previously built Orion to reflect changes to the vehicle. The team working on the spacecraft is taking a lean approach to development of the flight test elements to minimize cost and schedule. Using a boilerplate structure that doesn’t need to be recovered and having existing hardware provided a head start.

After building the structure, it was transported to Joint Base Langley-Eustis Jan. 26, where it was painted with specific black and white markings that will allow cameras to accurately track the vehicle during the flight test and allow for attitude and trajectory data collection during launch. In February, researchers conducted mass property testing by lifting and rotating the crew module on its side to determine its weight and center of gravity or balance. The test fixtures for the measurements were built in-house to accommodate the 22,000-pound structure and will be reused as well. To get accurate results during the uncrewed flight test planned for April 2019 and launched from Cape Canaveral Air Force Station in Florida, this simplified crew module will have the same outer shape and approximate mass distribution of the Orion crew module that astronauts will fly in, on future missions.

Following testing, the crew module was shipped to NASA’s Johnson Space Center in Houston where engineers are adding the avionics and other onboard computers and software. Work at Langley supporting AA-2 is continuing with fabrication of the separation ring that connects the crew module to the booster and provides space and volume for separation mechanisms and instrumentation.
Vice President Mike Pence returned to NASA’s Kennedy Space Center in Florida on February 20, this time to chair a meeting of the recently re-established National Space Council.

The primary focus for the Vice President’s trip was the second meeting of the National Space Council on February 21 in the high bay of the Center’s Space Station Processing Facility. The event’s theme was “Moon, Mars, and Worlds Beyond: Winning the Next Frontier” and included testimonials from leaders in the civil, commercial, and national security sectors about the importance of the United States’ space enterprise.

Vice President Pence noted that in December 2017, President Donald Trump signed an executive order that makes it a national policy of the United States to return humans to the Moon, put Americans on Mars, and bring renewed focus to human exploration in space.

Looking back to 1961, Pence recalled the flight in which Alan Shepard became the first American in space and, only eight years later, Apollo 11 astronauts were the first humans to walk on the Moon. The vice president then took a view ahead to a new era in space exploration.

On June 30, 2017, President Trump signed an executive order re-establishing the National Space Council to streamline and coordinate national space policy. The first meeting of the new National Space Council took place October 5, 2017, at the Smithsonian National Air and Space Museum’s Steven F. Udvar-Hazy Center in Chantilly, VA. Afterward, Acting NASA Administrator Robert Lightfoot praised the Vice President for calling for renewed U.S. leadership in space with NASA helping lead and shape the way forward.

Discussions during the current National Space Council meeting included President Trump’s Fiscal Year 2019 budget request of $19.9 billion for NASA. Vice President Pence also noted the expanded role of commercial companies called for in the president’s budget. Pence explained that the president has directed NASA to extend its exploration expeditions to the outer reaches of our solar system.

To do that, NASA’s Space Launch System (SLS) and Orion continue in development as critical backbone elements for the effort and for moving farther into deep space. SLS is a new heavy-lift rocket that will be capable of sending humans aboard Orion back to the Moon with an eye toward the Red Planet.

Noting the ongoing work at NASA’s multi-user spaceport, Vice President Pence praised the men and women who work there.

View recommendations from the meeting: [go.nasa.gov/2oL4QEB]
NASA's deep space exploration industry team held their sixth and largest-ever supplier's conference with more than 250 attendees representing over 90 companies from 34 states across the country. Small business owners, corporate executives and NASA leadership took time to meet with one another and get the latest program updates from the Orion, Space Launch System, and Exploration Ground Systems program managers. NASA Acting Administrator Robert Lightfoot and NASA Associate Administrator for Human Exploration Operations William Gerstenmaier provided Agency-level updates and NASA Center Directors Ellen Ochoa, Bob Cabana, Janet Kavandi, Todd May, and NASA Langley Research Center Deputy Director Clayton Turner provided updates on the new infrastructure improvements at each of their centers to support NASA’s future human exploration endeavors.

Other special guest speakers who made keynote addresses during the conference included Dr. Harrison Schmitt, Apollo 17 Astronaut and former US Senator; General William Shelton (Ret.) former Commander, Air Force Space Command; Scott Pace, Executive Director National Space Council; and Congressional representatives John Culberson (R-TX) Chair, House Appropriation, Subcommittee on Commerce, Justice and Science; Ed Perlmutter (D-CO), Members House Science, Space and Technology Committee, Space Subcommittee; and Dr. Brian Babin (R-TX) , Chairman of the House Subcommittee on Space.

Coalition for Deep Space Exploration Executive Director Mary Lynne Dittmar hosted a welcome reception for the suppliers as they arrived in Washington. The Coalition now has more than 70 member companies that support NASA's deep space planetary and human exploration initiatives. In addition, the industry team debuted a new video entitled Explore Without Limits that honors the dedication and innovation of the American workforce building the Nation’s deep space exploration systems.

Explore Without Limits: [bit.ly/ExploreWithoutLimits]

Photo highlights: [bit.ly/SupplierConf18]
ORION MAKES ITS WAY ACROSS THE U.S.A.

NASA and industry partners visited Oklahoma City the week of February 20 for Engineers Week, highlighting the work being done across the state to build and supply aerospace components for Orion and the Space Launch System. Orion and SLS team members were part of the groups that visited suppliers to view their facilities and share with them program progress toward Exploration Mission-1. One of these suppliers was Frontier Electronic Systems, a supplier to Orion and SLS. During the week, representatives visited schools and universities encouraging local students to pursue careers in the STEM fields of science, technology, engineering, and math.

Read more about Frontier Electronics: bit.ly/FES_Feb18

On February 6, team members Debbie Korth, Susan Baggerman, and Nujoud Merancy represented Orion at an engineering career fair at Clear Lake High School in Houston. By sharing their stories and giving students a glimpse at what goes into building a spacecraft like Orion, team members were able to open students’ minds to the possible career choices they could pursue. Engineers from all different disciplines attended and spoke with students about opportunities engineering careers could give them.

Read more about SEEC: bit.ly/SCH_SEEC18

Orion team members, as well as Astronaut Peggy Whitson, traveled to New York February 23–24 to bring Orion’s story to the annual Kid’s Week held at the Intrepid Sea, Air, and Space Museum. Kid’s Week is an event that invites children to engage in activities that explore how science intersects with arts, sports, and nature. Whitson participated in a talk show, gave a presentation about her journey to becoming an astronaut, and signed autographs for those attending. While at the event, kids also had the opportunity to experience a portal into the world of NASA that enabled live video discussions with NASA engineers stationed inside the Orion mock-up at NASA’s Johnson Space Center in Houston.

Learn more about 2018 Kid’s Week event: bit.ly/KidsWk_Intrepid18

Orion team members attended the 24th annual Space Exploration Educators Conference (SEEC), held February 1-3 at Space Center Houston. The three-day program provided K–12 teachers from around the world with information about, and opportunities to incorporate, space exploration into their respective curricula. Team members spoke with over 600 SEEC attendees about Orion and the Space Launch System. Educators also had the opportunity to explore the historical space artifacts in Space Center Houston and hear from astronauts, rocket scientists, and distinguished educators.

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Read more about SEEC: bit.ly/SCH_SEEC18
NASA’s Johnson Space Center in Houston selected San Diego Composites (SDC) of San Diego, CA, as 2017 Small Business Subcontractor of the Year for its support of NASA’s Orion spacecraft and the Agency’s mission to send humans to the Moon and beyond.

SDC is a subcontractor to Lockheed Martin, NASA’s prime contractor for the Orion spacecraft. The Orion Program Office manages development, building, and testing of the spacecraft out of Johnson Space Center.

Every fiscal year, the Small Business Industry Awards Program at each NASA center recognizes one small business subcontractor for outstanding efforts. An Agency-level award also is given each fiscal year, for which SDC has been nominated.

SDC has been a supplier for Orion since 2009, and is providing several elements for the spacecraft that will fly on Exploration Mission-1, including the ogive and fillet for Orion’s Launch Abort System, a safety mechanism that can carry the crew away from a hazardous situation on the launch pad or during ascent to space. The ogive provides a protective shell around the crew module that shields it from environmental conditions during launch, while the cone-shaped fillet connects the abort system to the ogive.

The company also characterizes materials and provides acceptance testing of structural elements for Orion to ensure they meet NASA standards.

San Diego Composites was recently acquired by Applied Composites Holding, LLC and will be continuing work on Orion.
SUPPLIER SPOTLIGHT
SYSTIMA TECHNOLOGIES, INC.

Located in Kirkland, WA, Systima’s 100 employees work to manufacture energetic systems and components, as well as complex integrated systems supporting the defense, space, and commercial markets. Founded in 2002, Systima has grown to support space and defense markets around the country. For the Orion Program, Systima successfully designed, developed, and produced the forward bay cover (FBC) thrusters. The three propellant-actuated thrusters retain the FBC, which will protect the top portion of the crew module during launch and in deep space until re-entry when the parachutes are deployed. The thrusters were successfully tested on Exploration Flight Test-1 in 2014. Systima has also contributed to other NASA programs, developing cubesat launch vehicle integration technologies, advanced green monopropellant technologies, and microthrusters.

FOLLOW THE PROGRESS OF NASA’S NEW SPACECRAFT FOR HUMAN EXPLORATION:

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MARCH 2018
AA-2 Crew Module Arrival at JSC
AA-2 Launch Booster Static Fire Test
Project Mars at SXSW
A structural test version of the intertank for NASA’s exploration class rocket, the Space Launch System, was loaded onto the barge Pegasus in February at NASA’s Michoud Assembly Facility in New Orleans. The flight version of the intertank will connect the core stage’s two colossal fuel tanks, serve as the upper-connection point for the two solid rocket boosters and house the avionics and electronics that will serve as the “brains” of the rocket.

Structural testing ensures the vehicle is safe for human exploration. Engineers at Marshall will push, pull, and bend the intertank with millions of pounds of force to ensure the hardware can withstand the forces of launch and ascent.

The intertank for NASA’s SLS rocket is the second piece of structural hardware for the rocket’s massive core stage to embark on the journey to NASA’s Marshall Space Flight Center. SLS generates $5.5 billion in economic impact to the American economy, including many businesses lined along the intertank’s river path to Alabama. SLS is designed to provide a strong foundation to explore deep space for at least a generation of Americans.

Read the full story: go.nasa.gov/2FUuUEH
Operators powered one of NASA’s SLS engines to 113 percent thrust level, the highest RS-25 power level yet achieved, during a test in February at Stennis Space Center near Bay St. Louis, MS. The test lasted 260 seconds with power levels at 113 percent for 50 seconds of the test. Like the rocket’s engines, other parts of SLS are being carefully examined to be human rated to carry astronauts safely into space.

Read the full story: go.nasa.gov/2H5zCi7

Tim Flores is the integration manager for stages in the SLS Program Office. Being a part of building the rocket that will help launch crews and supplies to the Moon and Mars makes him feel like he is contributing to an achievement that will change the world.

Read the full story: go.nasa.gov/2I5SnDm
WHAT’S NEW IN SLS SOCIAL MEDIA

Workers at Michoud Assembly Facility loaded a structural test version of the SLS intertank onto the barge Pegasus using self-propelled modular transporter technology. Watch the video here: bit.ly/2FSRK1L

SPACEFLIGHT PARTNERS:
Unison Industries, LLC

NUMBER OF EMPLOYEES: 2,000 +  LOCATION: Jacksonville, FL

WHAT THEY DO FOR SLS: Unison provides high-tension exciters, igniter leads and plugs for the RL10 upper stage engine and RS-25 engine.
The SLS team visited Stillwater and Oklahoma City, OK, in February to share SLS progress and to educate supplier and student audiences about America’s rocket, which is being built by more than 1,100 companies in 44 states and supports 31,000 jobs annually.
CREW ACCESS ARM ADDED TO MOBILE LAUNCHER
EGS MONTHLY HIGHLIGHTS

Orion Crew Access Arm Installed on Mobile Launcher

Exploration Ground Systems Talks Budget

VAB Fact-Filled Animation

Faces of EGS - Mike Van Houten
ORION CREW ACCESS ARM INSTALLED ON MOBILE LAUNCHER

As astronauts prepare for trips to destinations beyond low-Earth orbit, their last steps before boarding an Orion spacecraft will be across a crew access arm on the mobile launcher at NASA’s Kennedy Space Center in Florida. This week, the Agency reached an important milestone on the path to Exploration Mission-1 with the installation of the crew access arm at about the 274-foot level on the mobile launcher tower.

The Exploration Ground Systems team at Kennedy has been overseeing installation of umbilicals and other launch accessories on the 380-foot tall mobile launcher in preparation for stacking the first launch of the Space Launch System rocket, called the SLS, with an Orion spacecraft. The SLS will be the largest launch vehicle in the world, designed for missions beyond low-Earth orbit, carrying crew and cargo to the Moon and beyond. The initial configuration for what SLS can carry past low-Earth orbit and on to the Moon is more than 26 metric tons, with a final configuration of at least 45 metric tons.

The crew access arm installation marks the completion of 17 of the 20 major launch accessories and umbilicals that provide access, power, communication, coolant, fuel, and other services to the launch vehicle and spacecraft. The Interim Cryogenic Propulsion Stage Umbilical and a pair of Tail Service Mast Umbilicals are slated for installation in the spring/summer timeframe.

The crew access arm is made up of two major components — the truss assembly and the environmental enclosure, known as the “white room.” It is given that name not only because is painted white, but also because it is kept clean to avoid contaminants entering the spacecraft prior to flight. The crew access arm is designed to rotate from its retracted position and line up with Orion’s crew hatch. The arm will provide entry and emergency egress for astronauts and technicians into and out of the Orion spacecraft.

Read the full story at https://go.nasa.gov/2oAcH79.
EXPLORATION GROUND SYSTEMS TALKS BUDGET

After NASA’s budget was formally announced February 12, 2018, from the Agency’s Headquarters in Washington, D.C., Mike Bolger, Exploration Ground Systems (EGS) Program director, addressed members of the media that same day about the impacts the budget will have on the EGS Program.

During a gathering at the Kennedy Space Center News Center, Bolger responded to questions from members of traditional media and social media outlets. While speaking to the social media group, Bolger also explained the important role EGS plays in supporting the Agency’s Space Launch System rocket and Exploration Mission-1, the first integrated test flight with the Orion spacecraft.
What did it take to construct NASA's iconic Vehicle Assembly Building?

Learn the answers to these questions and more in this fact-filled animation.

View it at https://www.youtube.com/watch?v=q8vpU7ebtnI.
Mike Van Houten is the manager of the Launch Control System (LCS) Integrated Product Team (IPT) in Exploration Ground Systems (EGS) at NASA’s Kennedy Space Center.

His main responsibilities include serving as lead of the LCS hardware and software teams. The teams are responsible for providing an integrated system that will be used by Ground Subsystems, the Ground and Flight Application Software Team (GFAST), Launch Team training, and the operations team that will process and launch NASA’s Space Launch System (SLS) rocket for NASA’s Exploration Mission-1 and deep space exploration.

One of the team’s recent accomplishments was the deployment of the next version of the LCS software. Van Houten said this version has the capability to support hazardous operations in the Multi-Payload Processing Facility in early 2018, and the ability to communicate with each segment of the SLS rocket, which is composed of the Interim Cryogenic Propulsion Stage, the SLS core stage and ground systems, and the Orion spacecraft atop the SLS.

“I wanted to work for EGS because I saw an opportunity to take my years of experience with Enterprise software development and project management and apply them toward leading the team building the next version of Kennedy’s Launch Control System,” Van Houten said.

He’s always had a fascination with space and exploration. He became interested in space when he was a young child and watched the first space shuttle launch and landing on television.

“The notion that we could build a vehicle which could be launched into space, provide a platform for humans to work in space and then land like a plane catapulted me into science and engineering,” Van Houten said.

He has worked at Kennedy since August 2007. One of his fondest memories working at Kennedy was watching the last Space Shuttle mission, STS-135, lift off from Launch Pad 39A.

Van Houten’s hometown is Clifton, NJ. He attended the New Jersey Institute of Technology and earned a bachelor of science in Computer Science in 1994.

“The advice I would share with students interested in a career similar to mine is to study hard, take risks, participate in internship programs, and never give up on your dreams,” Van Houten said.

He has been married to his wife, Lori, for 20 years. His first car was a red 1976 Ford Monte Carlo. Van Houten’s hobbies include cooking, traveling, and reading books.
View the EGS 2017 Year in Review at https://go.nasa.gov/2C9twKC.

A bird’s eye view of the recent installation of the Crew Access Arm high up on the tower of the mobile launcher at NASA’s Kennedy Space Center. Photo credit: NASA/Gary Villa