



ESD

EXPLORATION SYSTEMS DEVELOPMENT

COMBINED MONTHLY HIGHLIGHTS

November / December 2013

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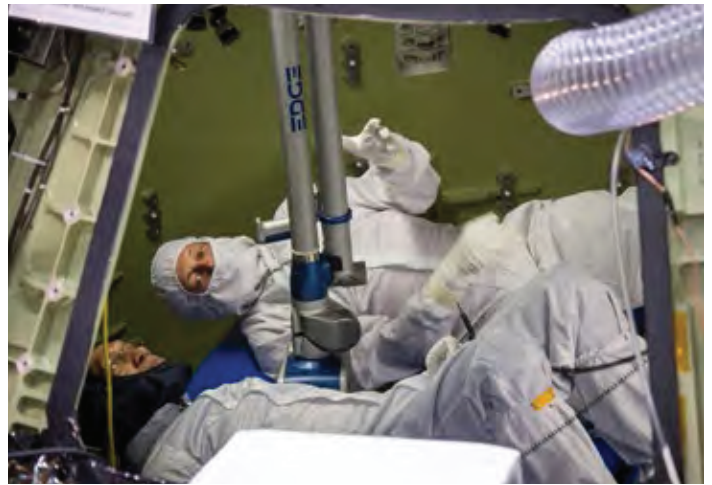
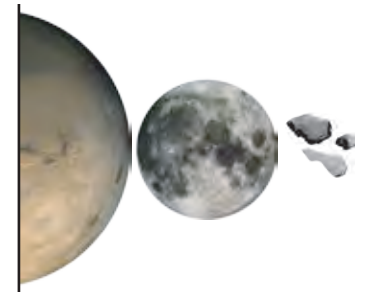
ORION

SPACE LAUNCH SYSTEM

GROUND SYSTEMS

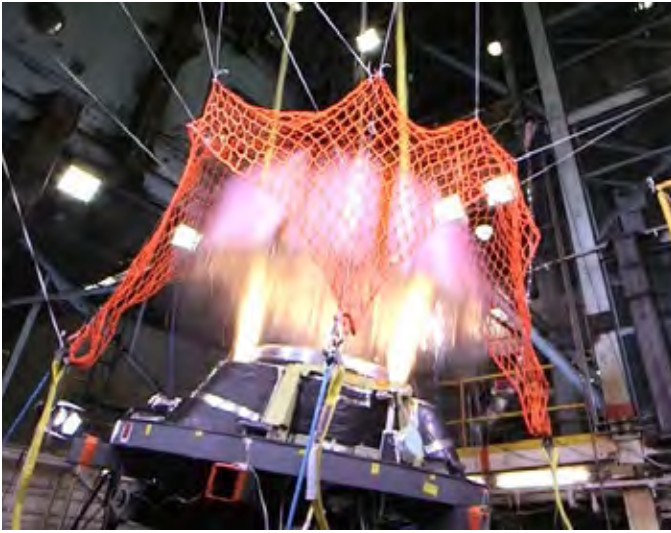
**MONTHLY
ACCOMPLISHMENTS**
December 2013

Orion



Orion team,
I could fill your inbox
with images of your
accomplishments
last year.

This year we will significantly ramp up our efforts for Exploration Missions 1 & 2 (EM-1/EM-2) as evidenced by key events such as the European Space Agency Preliminary Design Review, the Orion Delta Preliminary Design Review and our initiation of drawings and procurements for EM-1. Our friends in SLS and GSDO have similarly ambitious program milestones planned as we all move toward our goal of exploring the solar system.



Orion forward bay cover jettisons successfully

The first test to ensure Orion will successfully jettison its Forward Bay Cover (FBC) was conducted by Lockheed Martin on Dec. 19.

See video of the test at: <http://bit.ly/1ir8Mzp>

The FBC protects the top portion of the crew module during launch, orbital flight, and reentry. When Orion reenters the Earth's atmosphere from deep space, the FBC will be jettisoned at an altitude of approximately 23,000 feet. This event is crucial to mission success and crew safety—a successful jettison is required for deployment of the main parachutes.

This test will be followed by two more ground jettison tests, simulating different stress scenarios, and two air-drop tests which will simulate flight-like aerodynamic conditions. The next air drop test is scheduled for Jan. 15 from the U.S. Army's Yuma Proving Ground in Arizona.

Orion end of year stories

Work on NASA's new Orion spacecraft progresses as engineers pivot to 2014

<http://1.usa.gov/19dVQn>

2013 End of Year Orion/SLS Industry Accomplishments

<http://bit.ly/1cSBhQY>

Thank you for your year-round contributions to this program, and thank you to those who worked most of the holiday to keep us moving on the critical path. Your dedication to the mission and success of this program is greatly appreciated.

I remember Christmas Eve, 1968. Not because of the Christmas presents, but from watching and listening as the Apollo 8 crew sent images from the moon's orbit. They were more than just pictures, the astronauts' personal descriptions of what they were seeing made an emotional connection with the world.

That mission changed the way we viewed our planet. Although changing our view was not the primary reason for the mission, it was clearly one of the biggest and most enduring outcomes. This is a great example of how exploration can shape views and change culture in unexpected ways.

You are working on the next human exploration vehicle. We can only guess what new discoveries Orion will share as we send our crews further into the solar system. One of the great things about Orion is that we are not just designing a capability, but we are flying now (within 9 months). You may begin to sense the excitement around NASA, because our flight will prove that the United States is still in the human space exploration business.

Thank you again for all your hard work, and let's keep focused on Exploration Flight Test-1 mission success.

Video links:

Quarter 1: <https://vimeo.com/82298321>

Quarter 2: <https://vimeo.com/64176823>

Quarter 3: <https://vimeo.com/72924681>

Quarter 4: <https://vimeo.com/82298467>

Link to the video and audio of the Apollo 8 broadcast:

<http://1.usa.gov/1cvAg1w>

Mark Geyer



Orion heat shield arrives in ship shape at KSC

The heat shield that will protect NASA's Orion spacecraft during its first test mission shipped from Manchester, N.H., to Kennedy Space Center in Florida on NASA's Super Guppy aircraft on Dec. 4.

The heat shield had been under construction at Textron Defense Systems in Wilmington, Mass., since March. Journalists were invited to see the heat shield loaded onto the Super Guppy and interview Orion team members at both ends of the journey.

Before leaving New England, the Orion team visited several other companies building hardware for the spacecraft, including Yardney Technical Products in East Greenwich, R.I.; Fiber Materials in Biddeford, Maine; and Smith Connectors/Hypertac of Hudson, Mass.

The shield will protect the spacecraft from heat as it endures reentry temperatures near 4,000 degrees Fahrenheit while traveling more than 20,000 mph from a high-altitude orbit. The Orion heat shield is the world's largest ablative heat shield for a spacecraft and is critical for crew safety.



NASA's John Casper and Bill Hartwell and Lockheed Martin's West Womack visited Yardney Technical Products, Inc. to see the Orion EFT-1 batteries prior to shipment to KSC.

Read about the Orion team visit to Yardney Technical Products at: <http://bit.ly/1epESsf>





LAS tower completed in preparation for EFT-1

NASA engineers and contractors successfully completed the Orion Launch Abort System (LAS) tower this month, marking a milestone that puts NASA one step closer to the Exploration Flight Test-1 (EFT-1) mission.

The LAS, built at ATK and Aerojet and integrated at Kennedy Space Center in Florida, is comprised of three motors: the abort, attitude control, and jettison motors.

The LAS is designed to protect astronauts if a problem arises during launch by propelling the Orion spacecraft away from a failing rocket or launch pad emergency. The LAS tower will be encased by a fairing assembly that forms an aerodynamic shell for Orion and protects the crew module during launch. Both the LAS and the fairing assembly will be put to the test during EFT-1. Because EFT-1 is an uncrewed mission, only the jettison motor will be operational during the flight to detach the LAS from the crew module as it would during a normal crewed mission.

This flight test will provide information on the abort system's performance during the vehicle's trip beyond low Earth orbit.

In a worst-case scenario, the abort motor would fire 500,000 pounds of thrust to immediately propel the crew module off the launch pad. The attitude control motor then steers the vehicle away from danger by producing up to 7,000 pounds of thrust in multiple directions. Finally, the jettison motor pulls the LAS away from the crew module, allowing its parachutes to deploy and the vehicle to land safely. This was successfully demonstrated during the Pad Abort-1 integrated system flight test in 2010.

<http://vimeo.com/23167570>

More than 60 employees from NASA's Langley Research Center in Virginia, NASA's Marshall Space Flight Center in Alabama, and the Lockheed Martin industry team, helped design and build the LAS.



Technicians attached the fourth and final Ogive panel on the Orion ground test vehicle in Vehicle Assembly Building high bay 4 at NASA's Kennedy Space Center in Florida. The Ogive panels enclose and protect the Orion spacecraft and attach to the Launch Abort System. The test vehicle is being used by Ground Systems Development & Operations (GSDO) for pathfinding operations, including simulated manufacturing, assembly and stacking procedures.



EFT-1 simulation tests mission contingencies

NASA and Lockheed Martin flight operations personnel conducted the first Exploration Flight Test-1 (EFT-1) operations training simulation on Dec. 5. The flight control team for EFT-1, led by NASA Flight Director Mike Sarafin, executed the simulated flight from prelaunch at Cape Canaveral to recovery in the Pacific Ocean.

The simulation included several systems failures that exercised the flight rules and had the joint team send preplanned contingency commands. Some of the malfunctions required the flight director to contact the EFT-1 mission management team for authority to send unplanned commands to resolve inflight anomalies.

NASA and Lockheed Martin management considered the successful simulation a critical milestone in preparation for the September 2014 flight. This simulation was conducted in the Blue Flight Control Room in the Mission Control Center in Houston. This room was used for the first International Space Station mission more than 15 years ago.



Senior-level Astrium Space Transportation representatives toured the Space Operations and Simulation Center in Lockheed Martin's Waterton, Colo., facility near Denver this month.

Astrium is contracted to the European Space Agency to support Lockheed Martin's integration work on the European Service Modules that will support Orion's Exploration Missions 1 & 2.

Pictured left to right are: Dr. Stephen Walther, director of marketing, KAM USA and Russia, Astrium Space Transportation; Jim Crocker, vice president and general manager, civil space, Lockheed Martin Space Systems; Dr. Reinhold Lutz, senior vice president, Astrium Americas; and Scott Norris, senior manager, business development, Lockheed Martin Space Systems.

Orion mock-up makes a splash across the country



A test version of NASA's Orion spacecraft turned heads and excited space enthusiasts as it traveled across the country in December. Starting from NASA's Langley Research Center in Hampton, Va., the mockup took a four-week journey across the nation to the Naval Base San Diego in California. There, the test article will be used to support NASA's Underway Recovery Test in February 2014. The test will simulate the recovery of Orion during its first mission, Exploration Flight Test-1 (EFT-1), scheduled for September 2014.

During the cross-country move through Virginia, Tennessee, Arkansas, Texas, New Mexico, Arizona and California, social media users tracked its progress and shared their photos online by using the hashtag #SpotOrion. View some of their posts at:

https://twitter.com/NASA_Orion

During the holidays, the spacecraft made a two-week rest stop in Tucson, Ariz., where it was showcased at the Pima Air & Space Museum from Dec. 11 to Jan. 3.

While the spacecraft is in San Diego, it will undergo recovery testing in which it will be set adrift in open and unstable waters, providing NASA and the U.S. Navy the opportunity to recover the capsule into the well deck of the USS San Diego. While deployed, the team will seek out various sea states in which to practice the capsule recovery procedure in an effort to build their knowledge base of how the capsule recovery differs in calm and rough seas and what the true physical limits are.

NASA and the Navy practiced recovery in calm seas during a Stationary Recovery Test in August where the spacecraft was set adrift in the waters of Naval Station Norfolk in Virginia and recovered into the docked well deck of the USS Arlington.

View some of the news coverage of the cross-country trip at:

News 4 / Arkansas
KnoxViews News / Tennessee
KVOA / Tucson, Ariz.
KGUN9 / Tucson, Ariz.
KOLD/KMSB / Tucson, Ariz.

<http://bit.ly/1aHCb2X>
<http://bit.ly/1aHAzG9>
<http://bit.ly/1a8P0TN>
<http://bit.ly/19dWzxx>
<http://bit.ly/1dg4smV>



NASA extends deadlines for student exploration design challenge

NASA is extending deadlines for its Exploration Design Challenge, an educational program connected to Exploration Flight Test-1 (EFT-1) – the first mission for NASA's new Orion spacecraft scheduled to launch in September 2014 from Cape Canaveral Air Force Station in Florida.

The new deadline for high school students to submit payload design notebooks has been extended to Feb. 28. The deadline for all students to complete a radiation learning module and fly their names on EFT-1 is now June 30.

The challenge invites students from kindergarten through 12th grade to research and design proposed solutions to help protect astronauts from space radiation during Orion's long-duration deep space missions to asteroids or Mars.

The Exploration Design Challenge was launched in March through a partnership between NASA and Lockheed Martin Corp., in collaboration with the National Institute of Aerospace. The challenge brings cutting-edge learning to educators and students using standards-based activities, as well as print and video resources and technical guidance to help them learn how to solve difficult problems associated with human space exploration.

Participating students in grades kindergarten through eighth grade will analyze different materials that simulate space radiation shielding for human space travelers aboard the Orion spacecraft. After participating in activities guided by their teachers, students will recommend materials that best block harmful radiation.

Coming up in January 2014

- Parachute Test Vehicle drop test
- Service module structural loads testing
- Heat shield drilling operations
- End to end live sky test
- Orion All Hands



Joe LeBlanc works on the payload integration plan for the EDC student experiment that will fly in Orion's crew module during EFT-1.

Participating students in grades 9-12 can take the challenge a step further by designing a shield to protect a sensor inside Orion from space radiation. Five high school team designs will be selected for program review in March 2014, and the final winning design will be announced by the end of the school year. The high school team with the winning payload design will be flown to NASA's Kennedy Space Center in Florida to watch their experiment launch into orbit aboard Orion.

Be a part of space history. Get involved at:
<http://www.nasa.gov/education/edc/>



Read about Kent Beringer, NASA production lead on Orion:
<http://on.fb.me/JL2kqL>



Space Launch System

Highlights

December 2013



NASA and ATK Complete Avionics and Controls Testing for SLS Boosters



NASA and ATK have successfully completed two key avionics tests for the solid rocket boosters for SLS. The avionics tests, called hot fires, operate the booster's thrust vector control (TVC) system as if the booster were actually launching the SLS on a mission. The tests were conducted at ATK's facility in Promontory, Utah, and represent a significant milestone as well as validation of SLS cost-saving efforts. (NASA)

**I am
building
SLS**

Amir Abraham

Electromagnetic Environment
Effects Project Lead Engineer



To find out more about the people
who are building SLS, [click here](#).

Spaceflight Partners: L-3 Cincinnati Electronics

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 L-3 Cincinnati Electronics in Mason, Ohio.

On Oct. 29, L-3 Cincinnati Electronics (L-3 CE) celebrated completing preparations for delivery of the new SLS booster avionics to ATK, prime contractor for the SLS boosters.

Culminating from five years of development, L-3 CE delivered eight avionics control units to support system integration testing at ATK. Successful completion of this testing is a prerequisite to flight. The avionics provided by L-3 CE will fly on ATK's twin Solid Rocket Boosters for the SLS exploration test missions, EM-1 and EM-2, including the first with crew on EM-2.

Russ Walker, president of L-3 CE, said, "The SLS avionics team has worked very hard supporting this key delivery. All of us working the program understand the importance of meeting key SLS milestones and offering an affordable solution. The L-3 CE, ATK and NASA teams are delivering on those objectives."

L-3 CE is scheduled to complete booster avionics Critical Design Review in the first quarter of 2014. L-3 CE is a critical avionics supplier to both the SLS booster and core stage elements.



Participating in the Oct. 29 celebration at L-3 Cincinnati Electronics are, from front left, Paul Karner, ATK's senior program manager, SLS Booster Avionics and Control Systems; David Wood, NASA chief engineer for SLS Boosters; and Bruce Tiller, NASA deputy manager for SLS Boosters. (L-3)



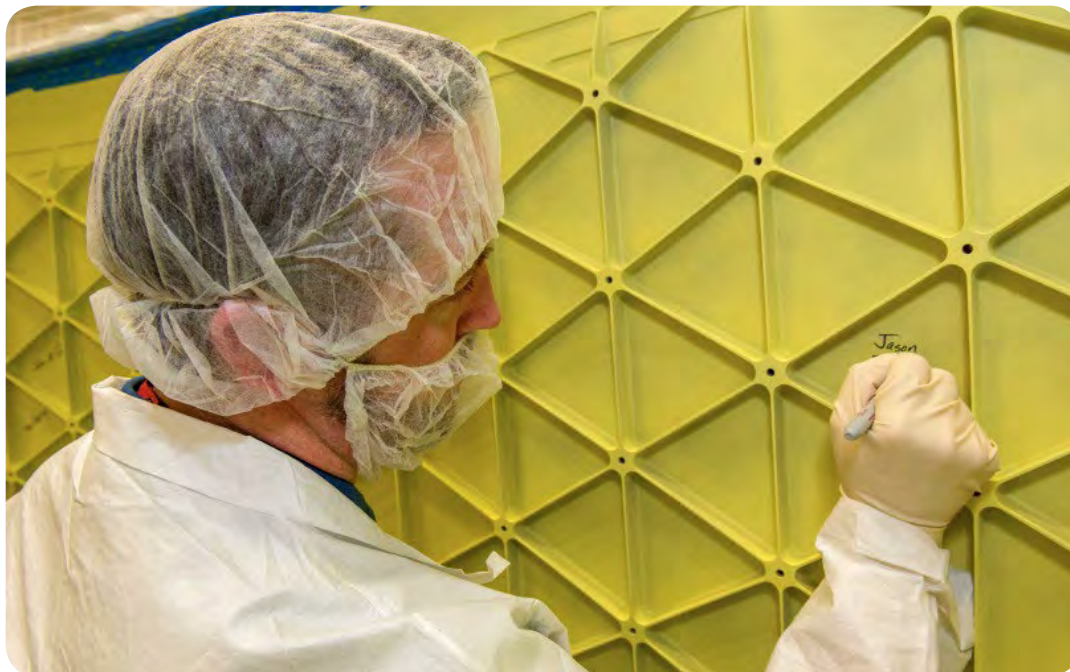
Bruce Tiller, NASA deputy manager for SLS Boosters, speaks to L-3 employees and ATK leaders during a celebration for completing preparations for delivery of the new SLS booster avionics to ATK. (L-3)

SLS Chief Engineer Driven by 'Challenge' of Building America's Next Great Rocket



During the Saturn V days, a 10-year-old boy came to NASA's Marshall Space Flight Center with his dad and uncle for an open house. There to shake that young boy's hand was Wernher von Braun, the first center director of Marshall who would later be hailed as one of the all-time champions of space exploration. That day, as S1 stage engines ignited every hour in the test stand, something ignited in that little boy, as well—a dream to one day work "at one of the coolest places" he'd ever been. Today, he's living that dream. That boy was Garry Lyles, now responsible for the overall system design of the most powerful rocket in history—NASA's SLS. To read Lyles' full story, [click here](#). (NASA/MSFC)

Signatures to Space in 2014



Jason Eldridge, an ERC Inc. employee supporting the Materials & Processes Laboratory at NASA's Marshall Space Flight Center, signs his name on the interior of the adapter that will connect the Orion spacecraft to a United Launch Alliance Delta IV rocket for EFT-1. Marshall Center team members who were involved in the design, construction and testing of the adapter had the opportunity to autograph it before the hardware is shipped to NASA's Kennedy Space Center in February. Eldridge was on a team that performed ultrasonic inspections on the adapter's welds—ensuring they are structurally sound. (NASA/MSFC)

First Welded Dome Completed at Michoud Assembly Facility

The first SLS core stage forward liquid oxygen (LO₂) tank dome recently was completed on the Circumferential Dome Weld Tool at NASA's Michoud Assembly Facility in New Orleans. The dome was welded as a "confidence" article to ensure that the weld tool can produce the qualification and flight domes. The SLS core stage liquid hydrogen and liquid oxygen tanks will each have two domes similar to the confidence article.

The dome will be used to develop inspection techniques for the flight articles. It also will be used for future confidence welding on the Vertical Assembly Center— one of the world's largest welding tools, scheduled to be completed in 2014. The foundation recently was poured for the tool, and is currently being cured. It required 90 truckloads of material to pour the 900 cubic yards of concrete for the groundwork. To see a video of the pour, [click here](#).

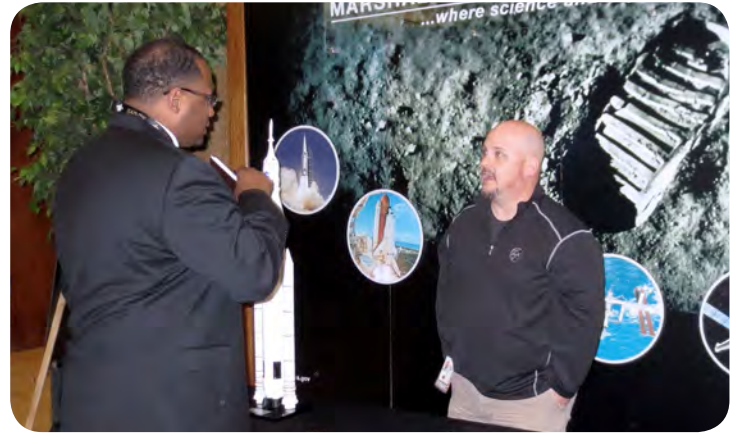


NASA/Michoud

SLS On the Road...



SLS Program Manager Todd May talks about America's "Next Great Ship" on Dec. 5 at the Huntsville Alabama L5 Society meeting. (NASA/MSFC)



Kirk Pierce, a Media Fusion employee supporting the SLS Program Office, shares information about the rocket with Elijah Williams, MSFC Legislative Affairs Liaison, Dec. 4 at an exhibit outside the Marshall Center's Morris Auditorium. (NASA/MSFC)



A 30-foot inflatable of the SLS rocket was on display at the Iron Bowl, held Nov. 30 at Auburn University. (NASA/MSFC)

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

Follow SLS on:



SLS on Deck:

- Avionics First Light
- MSA-2 delivery
- Bolden visit to MAF



PROGRAM HIGHLIGHTS • DECEMBER 2013

Emergency Egress Vehicles Arrive at Kennedy

With crewed launches on NASA's Space Launch System (SLS) and Orion spacecraft approaching, the Ground Systems Development and Operations (GSDO) Program at Kennedy Space Center in Florida led the effort to select an emergency egress vehicle that future astronauts could quickly use to leave the Launch Complex 39 area in case of an emergency. The first of four refurbished Mine-Resistant Ambush-Protected (MRAP) vehicles was shipped from the U.S. Army Red River Depot in Texarkana, Texas, and arrived at the center Dec. 5.

During crewed launches, the MRAP will be stationed by the slidewire termination area at the pad. In case of an emergency, the crew will ride a slidewire to the ground and immediately board the vehicle for safe egress from the pad. The existing bunkers around the pads would be used only if evacuation was not possible.

All four vehicles were transferred from the Army at no cost to NASA. As each one arrives, they will be processed in and then transported to the Rotation, Processing and Surge Facility near the Vehicle Assembly Building for temporary storage. The vehicles will undergo some modifications to meet NASA's emergency egress requirements.

Danny Zeno, a GSDO operations integration engineer, led a two-year study of several emergency egress concepts with a team of people from NASA centers and programs. The team selected the slidewire system and the Army's MRAP Caiman, a military vehicle that



The first of four new emergency egress vehicles, called Mine-Resistant Ambush-Protected, or MRAP, vehicles arrived at Kennedy Space Center in Florida from the U.S. Army Red River Depot in Texarkana, Texas.

was used for operations in Iraq and Afghanistan.

"This is definitely an upgrade from the space shuttle-era M-113 tank design," said Zeno. "Working across agencies helped us to select the most versatile vehicle possible for NASA's purpose."

The 40,000-pound, heavy-duty vehicles will provide protection against chemicals and projectiles that could be carried through the air during a catastrophic event at the pad.

For the complete story, visit <http://go.nasa.gov/JKSchD>



Inside the Vehicle Assembly Building at Kennedy Space Center, preparations are underway to lower crawler-transporter 2 from jack stands so that work can begin to reinstall the large crawler tracks on Dec. 3. The crawler is being prepared for rollout in January 2014 to test the new bearings that were recently installed.



NASA Advisory Council members get an up-close look at modifications to Launch Pad 39B Dec. 11 during a tour of Kennedy Space Center in Florida.



Crawler-transporter 1 approaches the top of Launch Pad 39A after traveling along the crawlerway at Kennedy Space Center on Dec. 3. New jacking, equalizing and leveling, or JEL, hydraulic cylinders were installed on CT-1 and are undergoing a leveling and turning test as the crawler travels along the slope. Photo credit: NASA/Daniel Casper

Employee Spotlight - Eric Perritt

Eric Perritt is an Operations Integration engineer in the GSDO Program at Kennedy Space Center. Perritt has worked at the center for 19 years and was selected as GSDO Employee of the Month for December.

He started as a volunteer in 1994 and was subsequently hired in the Payload Processing Directorate.

For GSDO, Perritt's main responsibility is integrating various Operations groups to prepare for reviews such as the Preliminary Design Review (PDR), Critical Design Review (CDR) and Operational Readiness Review (ORR). He also integrates the operations teams to produce an overall GSDO Flight Processing Integrated Timeline depicting all of the activities the program will be responsible for in order to process NASA's Space Launch System (SLS) and Orion vehicles. He also supports cross-program activities such as preparing for the Certification of Flight Readiness.

The CDR demonstrates that the maturity of the design is appropriate to support a full-scale fabrication, assembly, integration and test. It also determines that the technical effort is on track to complete the system development, meeting performance requirements within the identified cost and schedule constraints.

The SAR verifies the completeness of the specific end products in relation to their expected maturity level, assesses compliance to stakeholder expectations, and ensures that the system has sufficient technical maturity to authorize its shipment to the designated operational facility or launch site.



The ORR ensures that all system and support (flight and ground) hardware, software, personnel, procedures, and user documentation accurately reflect the deployed state of the system and are operationally ready.

One of his recent major tasks was the coordination and integration of the Architecture and Operations portion of the PDR. He also worked with others to coordinate an approach for GSDO to achieve the System Acceptance Review/ORR reviews and is working across programs (SLS and Orion) to establish processes to ensure consistent and accurate input to the integrated timeline.

Perritt's first car was a 1984 white Mercury Cougar. He enjoys working out, traveling, going to the beach, watching football (especially Penn State games) and science fiction, and playing strategy games.

He has one dog that he adopted four years ago, a Siberian husky named Oginalli.

His parents and a brother live near Syracuse, New York, and his sister lives in Atlanta.



An aerial view of the Vehicle Assembly Building, or VAB, in the Launch Complex 39 area at Kennedy Space Center in Florida. The Launch Control Center is in front of the VAB. To the right is the mobile launcher that will be used to transport NASA's Space Launch System rocket and the Orion crew capsule to Launch Pad 39B.

To view the most recent
ESD Quarterly Report, visit:
<http://vimeo.com/82298467>

