National Aeronautics and Space Administration

EXPLORATION GROUND SYSTEMS

HIGHLIGHTS

2017 YEAR IN REVIEW

Team:

It has been another exciting year for Exploration Ground Systems!

In 2017, we continued to make steady progress towards completing the launch infrastructure and building the ground processing team that will checkout and launch NASA's Space Launch System and Orion spacecraft. The year has been full of challenges and opportunities -- I am really proud of how our team has rallied around each other in support and in celebration as we achieve our goals.

Today, our major construction projects are fundamentally complete and we are outfitting and testing our ground systems. We also have delivered much of our critical software, and our operations team is developing the schedules and procedures that we need to conduct ground operations. As we prepare for the year ahead, I hope that the success stories and images of progress included here will make you as confident as I am that when the flight hardware shows up, we are going to be ready!
I continue to be both honored and humbled to be making spaceflight history with you!

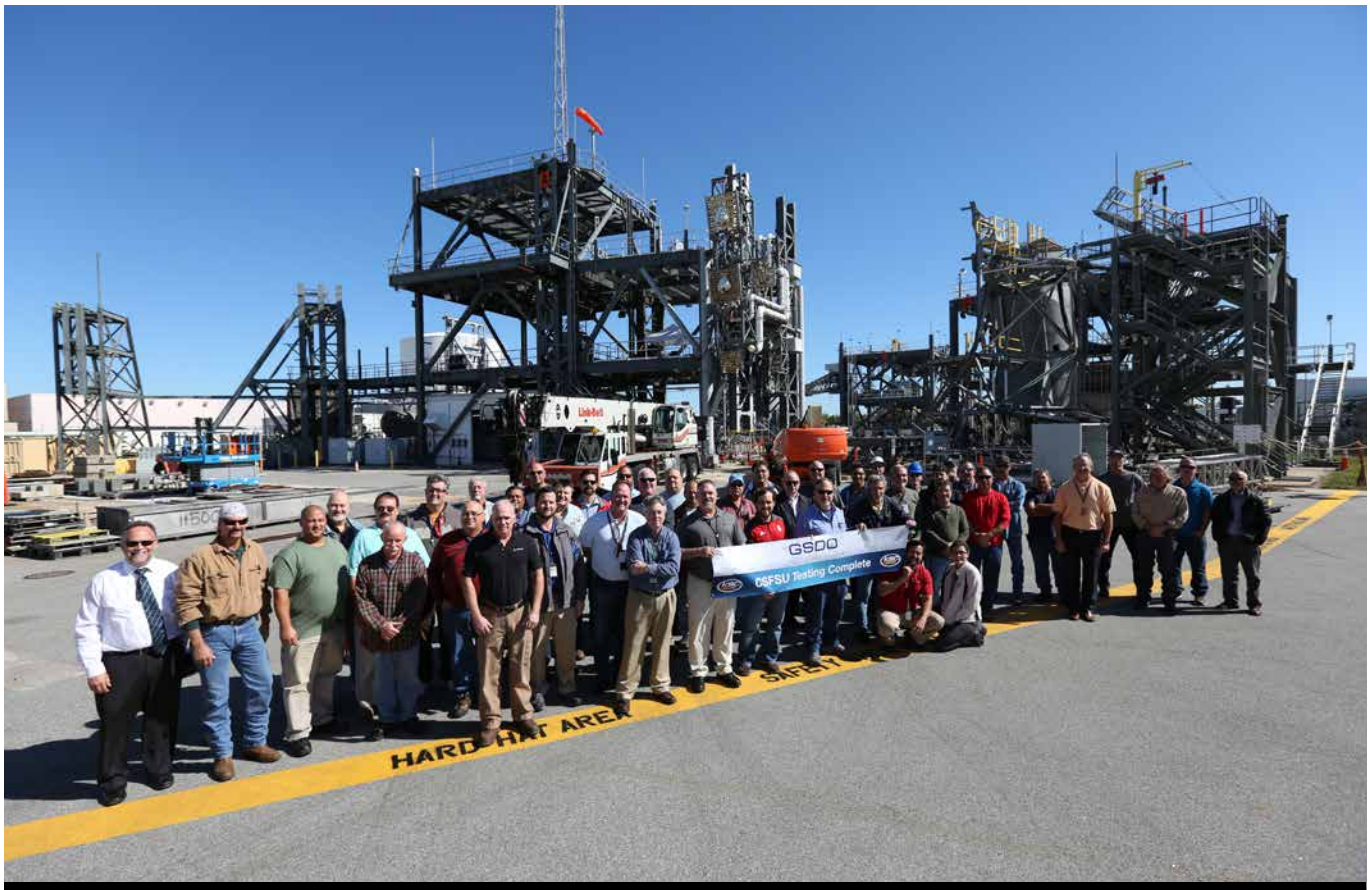
Michael J. Bolger
Manager, Exploration Ground Systems

Workers signed the final platform, A North, in the transfer aisle of the VAB on Jan. 10, 2017. The platform was lifted, installed and secured on its rail beam high up on the north wall of High Bay 3. Photo credit: NASA/Dimitri Gerondidakis

JANUARY

NASA, CONTRACTORS SIGN FINAL PLATFORM IN VEHICLE ASSEMBLY BUILDING

Kennedy Space Center's Engineering Directorate coordinated a platform beam signing event to celebrate the culmination of the NASA and contractor team's last several years of study, design, construction and installation of 20 new work platforms in High Bay 3 of the Vehicle Assembly (VAB). Workers signed the final platform, A North, in the transfer aisle of the VAB. The platform was lifted, installed and secured on its rail beam high up on the north wall of High Bay 3. The installation of the final topmost level completes the 10 levels of work platforms, 20 platform halves altogether, that will surround NASA's Space Launch System rocket and the Orion spacecraft to allow access during processing for missions, including the first uncrewed flight test of Orion atop the SLS rocket. Exploration Ground Systems, with support from the center's Engineering Directorate, is overseeing upgrades and modifications to the VAB, including installation of the new work platforms.



The test team holds a signed banner Jan. 24, 2017, at the Launch Equipment Test Facility at Kennedy Space Center. Behind them are some of the test structures used to test the launch umbilicals. Testing of the Core Stage Forward Skirt Umbilical (CSFSU) for NASA's Space Launch System is complete and the umbilical was transported to the mobile launcher area. The umbilical will be prepared for installation on the tower of the mobile launcher. Photo credit: NASA/Cory Huston

JANUARY

TEST OF LAUNCH UMBILICALS AT HALFWAY POINT FOR MOBILE LAUNCHER SYSTEM

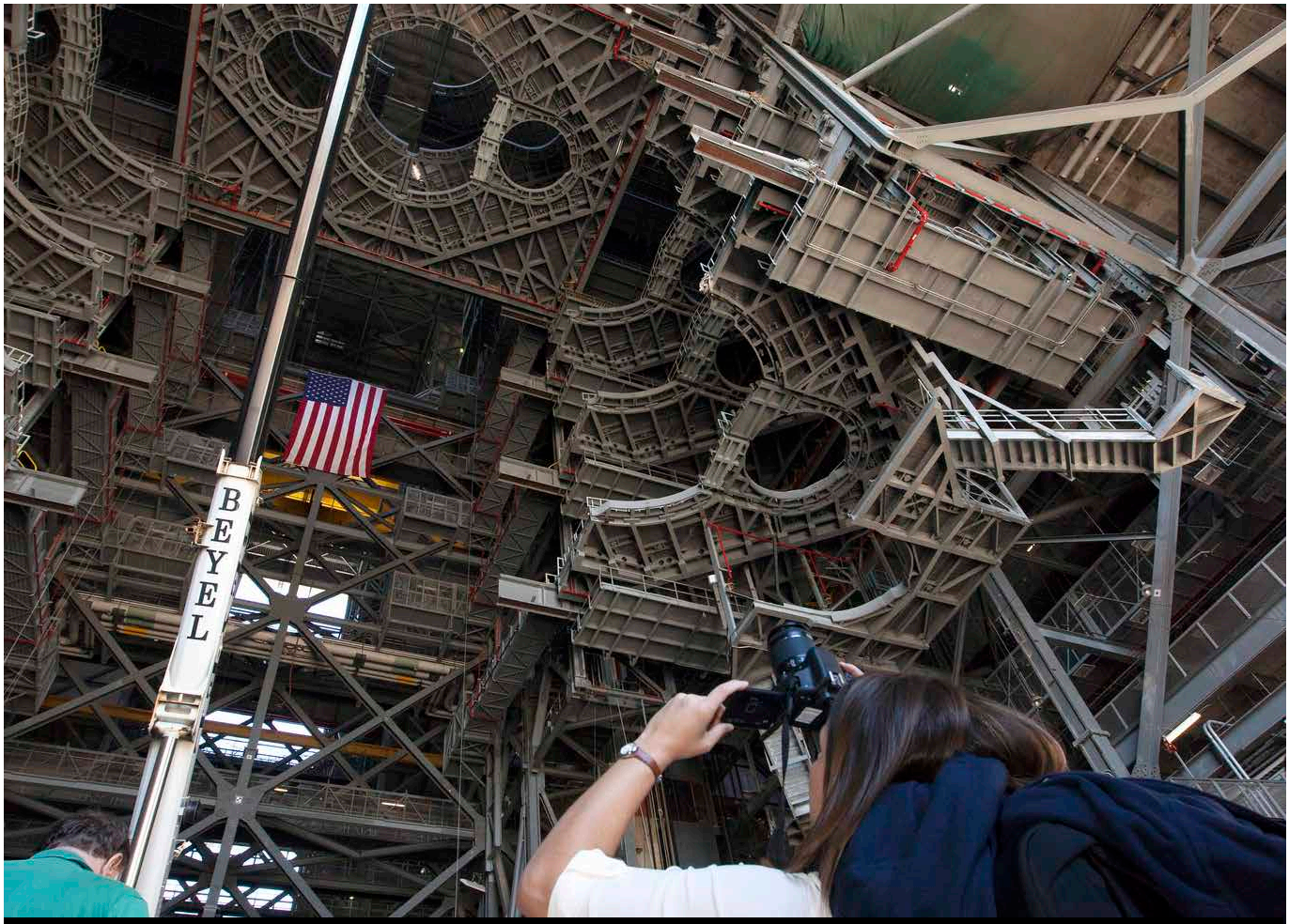
NASA reached the halfway point on testing of the launch umbilicals for its Space Launch System (SLS) rocket and Orion spacecraft at the Launch Equipment Test Facility at Kennedy Space Center in Florida.

The Core Stage Forward Skirt Umbilical (CSFSU) underwent testing for four months. A team of engineers and technicians with the Engineering Directorate and Exploration Ground Systems, along with support contractors, conducted the tests. The CSFSU was attached to a Vehicle Motion Simulator at the LETF and tests confirmed the CSFSU load limits, its ability to disconnect before liftoff and that it is functioning properly and ready to be installed on the mobile launcher.

The CSFSU will be located at about the 180-foot level on the mobile launcher tower, above the vehicle liquid oxygen tank. During processing, the umbilical will be mated to the core stage forward skirt to provide commodities to the SLS rocket, and then disconnect and swing away before launch. Its main purpose is to provide conditioned air and gaseous nitrogen to the SLS Core Stage Forward Skirt.

The umbilical was transported to the mobile launcher area in December 2016, where it was prepared for installation on the tower of the mobile launcher.

FEBRUARY



Members of the news media viewed the 10 levels of new work platforms in High Bay 3 inside the Vehicle Assembly Building during a multi-user tour of Kennedy Space Center with Center Director Bob Cabana on Feb. 17, 2017. The final platform, A north, was recently installed. Photo credit: NASA/Kim Shiflett

MEDIA VIEW NEW WORK PLATFORMS FOR NASA'S SPACE LAUNCH SYSTEM

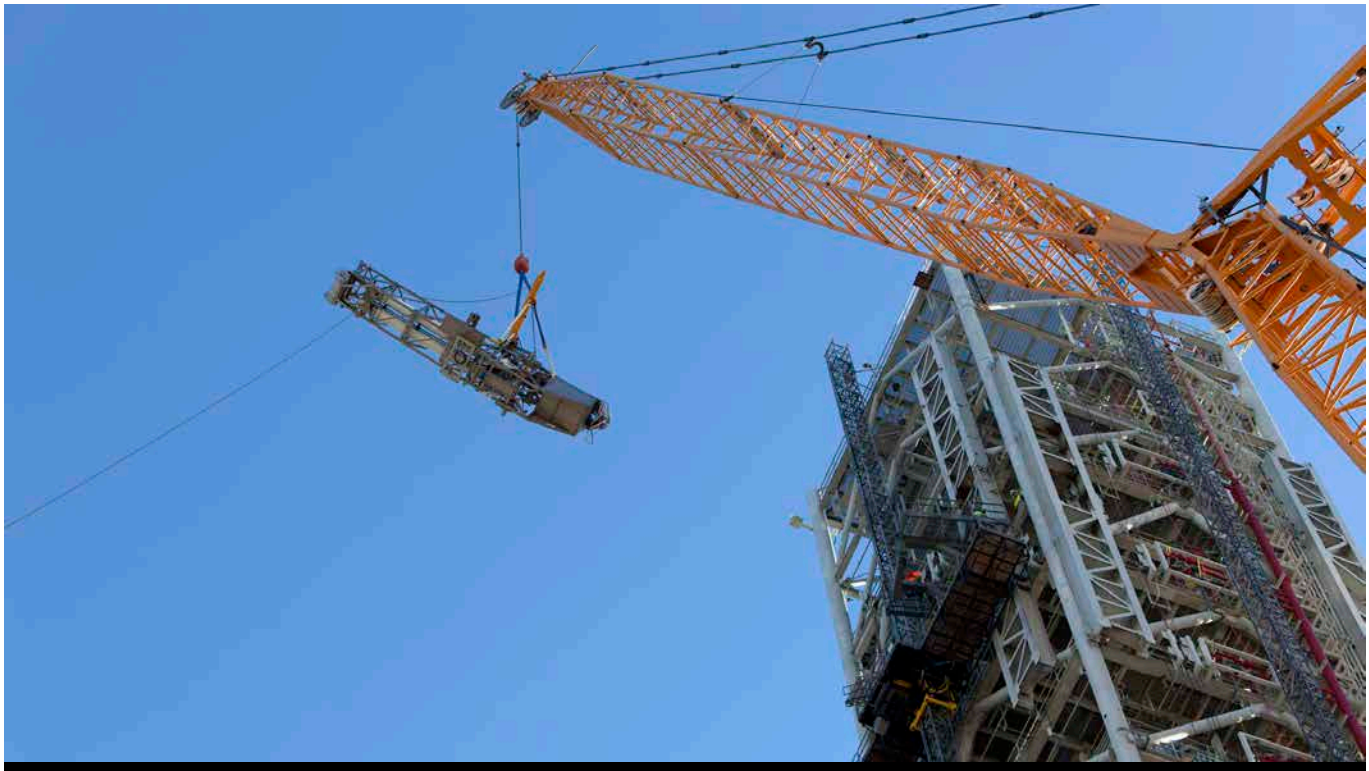
Members of the news media viewed the ten levels of new work platforms inside High Bay 3 of the Vehicle Assembly Building at Kennedy Space Center. Work to install the platforms came to conclusion Jan. 12, as the final work platform, A north, was lifted, installed and secured on its rail beam on the north wall of the high bay inside the iconic facility.

Twenty platform halves will surround NASA's Space Launch System (SLS) rocket and Orion spacecraft atop the mobile launcher and allow access during processing for missions, including the first flight test of Orion atop the SLS.

With the goal of being a multi-user facility, the new platforms were designed to be adjusted up and down, and in and out on their rail beams in order to accommodate the SLS and its solid rocket boosters, as well as other vehicles.

Design of the new platforms began in 2010. NASA awarded a contract to modify High Bay 3 to the Hensel Phelps Construction Co. of Greeley, Colorado, in March 2014. Hundreds of NASA and contractor workers were involved in the design, manufacture and installation of the platforms.

The platform levels are A, B, C, D, E, F, G, H, J and K. With the K-level being the lowest and the A-level the highest platforms.



A crane and rigging are used to lift the Orion Service Module Umbilical (OSMU) high up for installation on the mobile launcher tower at Kennedy Space Center on March 16, 2017. The OSMU will transfer liquid coolant for the electronics and air for the Environmental Control System to the Orion service module that houses these critical systems to support the spacecraft. Photo credit: NASA/Leif Heimbold

FIRST UMBILICAL INSTALLED ON MOBILE LAUNCHER FOR NASA'S SPACE LAUNCH SYSTEM AND ORION

MARCH

The first launch umbilical for NASA's Space Launch System (SLS) and Orion spacecraft was installed on the mobile launcher tower March 16 at Kennedy Space Center in Florida. The Orion Service Module Umbilical, or OSMU, was installed high up on the tower at about the 260-foot level.

"Installation of the OSMU is a major milestone for the mobile launcher team," said Sam Talluto, deputy project manager. "This is the first of multiple umbilicals and launch accessories that will be installed."

The tower on the mobile launcher will be equipped with several connections, called launch umbilicals, which will connect to the SLS core stage and twin solid rocket boosters, the interim cryogenic propulsion stage and the Orion spacecraft. They will provide power, communications, coolant and fuel.

The OSMU will connect from the mobile launcher tower to the Orion service module. Prior to launch, the umbilical will transfer liquid coolant for the electronics and purge air/ GN2 for environmental control to the Orion service module that houses these critical systems to support the spacecraft. The umbilical also will provide purge air/GN2 for environmental control to the Launch Abort System. Before launch, the OSMU will tilt up and the umbilical lines will disconnect.

The first integrated launch of SLS and Orion, Exploration Mission-1, will send the spacecraft to a stable orbit beyond the Moon. Orion will return to Earth and be recovered from the Pacific Ocean. The mission will demonstrate the integrated performance of the SLS rocket, Orion and ground support teams.

CRAWLER-TRANSPORTER 2 TAKES TEST DRIVE ALONG CRAWLERWAY

Crawler-transporter 2 (CT-2) moves slowly along the crawlerway on its way back to the Vehicle Assembly Building at Kennedy Space Center on March 21, 2017. The crawler took a trip to the pad A/B split to test upgrades recently completed that will allow the giant vehicle to handle the load of the agency's Space Launch System rocket and Orion spacecraft atop the mobile launcher. Photo credit: NASA/Leif Heimbold

MARCH

NASA's crawler-transporter 2 (CT-2) took a test drive along the crawlerway at Kennedy Space Center on March 21, 2017, to determine the structural dynamics and loading environments of the crawler's recent upgrades. The test was performed to ensure that the crawler is ready to support the first integrated flight of the agency's Orion spacecraft atop the Space Launch System.

The unloaded CT-2 rolled from the crawler yard along the crawlerway to the pad A/B split for the first leg of the trip and traveled back to the mobile launcher platform park site near the Vehicle Assembly Building. For the loaded test, the crawler picked up Mobile Launch Platform 1 at the park site and returned to the pad A/B split. Engineers took measurements during the entire trek using accelerometers, strain gauges and pressure transducers. The data collected will be used to validate the dynamic model of the integrated SLS.

CT-2 is the vehicle that will carry the SLS rocket and Orion spacecraft on the mobile launcher to pad B for launch. The behemoth vehicle recently was upgraded to support the heavier load of the SLS atop the mobile launcher.

Upgrades to the crawler included installation of new generators, gear assemblies, jacking, equalizing and leveling (JEL) hydraulic cylinders, roller bearings and brakes. Other systems also were upgraded.

Exploration Ground Systems is overseeing upgrades to facilities and ground support equipment necessary to support the launch of deep space missions, including the Journey to Mars.

NASA engineers and test directors gathered in Firing Room 3 in the Launch Control Center to watch a demonstration of the automated command and control software for NASA's Space Launch System rocket and Orion spacecraft. In front, far right, is Charlie Blackwell-Thompson, launch director for Exploration Mission-1. Photo credit: NASA/Bill White

NEW GROUND LAUNCH SEQUENCER SOFTWARE DEMONSTRATED IN LAUNCH CONTROL CENTER

APRIL

A demonstration of the automated command and control software for NASA's Space Launch System (SLS) rocket and Orion spacecraft, took place in Firing Room 3 in the Launch Control Center at the Kennedy Space Center. The software, called the ground launch sequencer, will be responsible for nearly all of the launch commit criteria during the final phases of launch countdowns.

The Ground and Flight Application Software Team, or GFAST, demonstrated the software for Charlie Blackwell-Thompson, launch director for the first integrated flight of the SLS and Orion spacecraft. Also attending were representatives from the NASA Test Director's Office.

The software is in the advanced stages of development. It includes nearly all of the core capabilities required to support the initial use during Ignition Over-Pressure/Sound Suppression and follow-on tests through launch of the agency's SLS rocket and Orion spacecraft. The suppression stage ensures the water dampening system initiates in the final second of launch countdown. It also produces the pattern and volume needed to dampen the pressure waves and acoustic environment caused by the firing of the SLS core stage RS-25 engines and solid rocket motors.

The software was developed by Exploration Ground Systems' Command, Control and Communications teams at the center. Development of the software continued, with a goal of beginning verification and validation of the software in summer 2017.

Launch Complex 39B current and past NASA and contractor workers gathered at pad B on May 17, 2017, to mark the 50th anniversary of the launch complex at Kennedy Space Center. Upgrades to the surface of pad B, as well as the systems below and surrounding the pad will support the new processing and launch requirements for NASA's Space Launch System and the Orion spacecraft for deep space missions, including the Journey to Mars. The modifications and improvements to processing and launch facilities will support Kennedy as a multi-user spaceport for government and commercial launches for years to come. Exploration Ground Systems is overseeing upgrades and modifications to the pad. Photo credit: NASA/Kim Shiflett

KENNEDY SPACE CENTER CELEBRATES 50TH ANNIVERSARY OF LAUNCH PAD 39B

Launch pads built on a swamp. A humble beginning for the two pads, A and B, at Launch Complex 39B at Kennedy Space Center. They were originally constructed in the 1960s as clean pads and served as a starting point for Apollo and our journey to the Moon. Now, Launch Complex 39B will serve as the launch site for NASA's Space Launch System rocket and Orion spacecraft on deep space missions, including the Journey to Mars.

Time flies, and NASA celebrated the 50th anniversary of pad B, the launch site for one Apollo/Saturn V launch, three Skylab missions using the Saturn 1B rocket, one Apollo-Soyuz Test Project mission that also used a Saturn 1B, and 58 space shuttle launches.

Construction of the pad began in December 1964 and was completed in April 1967.

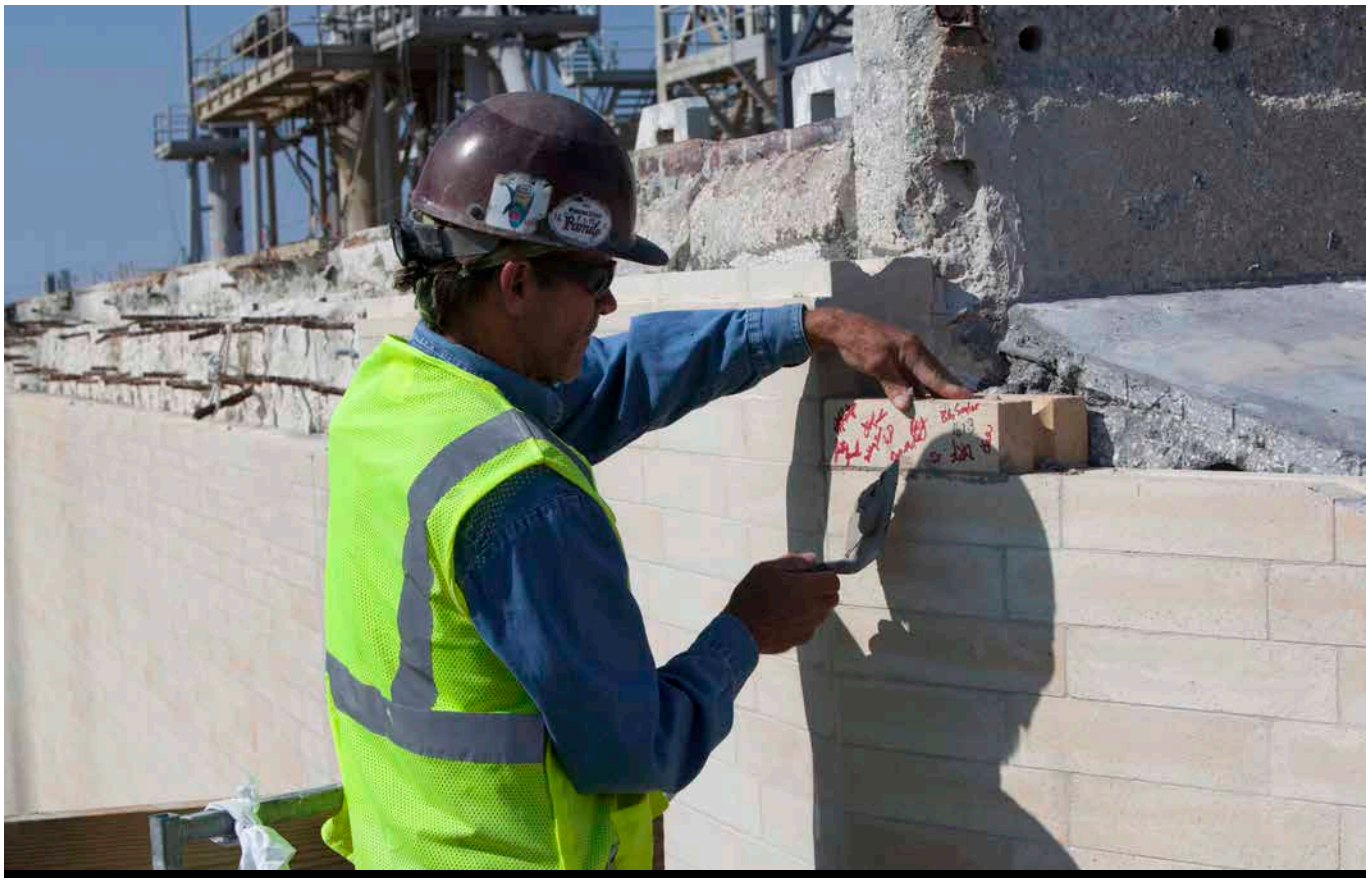
To fill in and build up the area, hundreds of tons of sand was dredged from the Atlantic Ocean and pumped along a road to pad B. The behemoth structure of the pad required 68,000 cubic yards of concrete and 5,100 tons of reinforced steel.

The first launch from pad B was Apollo 10 on May 18, 1969. It also was the first use of the pad's water deluge system, used to cool the flame deflector in the flame trench after rocket ignition.

Pad B was used to launch three of the four missions of the Skylab program. The crewed missions were Skylab 2 on May 25, 1973; Skylab 3 on July 28, 1973; and Skylab 4 on Nov. 16, 1973. The crewed Apollo-Soyuz Test Project mission launched from pad B on July 15, 1975.

Read the complete story at https://go.nasa.gov/2s55nn3.

MAY



A construction worker installs one of the final bricks on the north side of the flame trench at Launch Complex 39B on May 9, 2017, at Kennedy Space Center. The walls of the flame trench are being upgraded to withstand the intense heat and fire at launch of NASA's Space Launch System rocket with Orion atop. Photo credit: NASA/Leif Heimbold

FINAL BRICK INSTALLED IN LAUNCH COMPLEX 39B FLAME TRENCH

MAY

Intense heat and fire will fill the north side of the flame trench beneath the pad when NASA's Space Launch System (SLS) rocket and Orion spacecraft lift off from Launch Complex 39B at Kennedy Space Center. A project to upgrade the walls of the flame trench to withstand these conditions recently was completed.

All of the new heat-resistant bricks now are in place in the flame trench below the surface of the pad. Construction workers installed the final brick May 9, 2017, completing about a year's worth of work on the walls on the north side of the flame trench to support the launch of the SLS rocket and Orion spacecraft on deep space missions, including the Journey to Mars.

About 96,000 heat-resistant bricks, in three different sizes, were secured to the walls using bonding mortar in combination with adhesive anchors. The flame trench will be able to withstand temperatures of up to 2,000 degrees Fahrenheit at launch of the rocket's engines and solid rocket boosters.

"The flame trench has withstood so many historical launches, and we are giving it new life to withstand many more," said Regina Spellman, the launch pad senior project manager with Exploration Ground Systems.

The north side of the flame trench is about 571 feet long, 58 feet wide and 42 feet high.

A new flame deflector soon will be installed that will safely contain and deflect the plume exhaust from the massive rocket to the north during launch. Two side flame deflectors, repurposed from space shuttle launches, will be refurbished and reinstalled at pad level on either side of the flame trench to help reduce damage to the pad and SLS rocket.

TURN BASIN PREPPED FOR SPACE LAUNCH SYSTEM CORE STAGE ARRIVAL

Modifications are underway at the Launch Complex 39 turn basin wharf at Kennedy Space Center to prepare for the arrival of the agency's massive Space Launch System (SLS) core stage aboard the barge Pegasus. A crane will be used to lift up precast concrete poles and position them to be driven to a depth of about 70 feet into the bedrock below the water around the turn basin. The upgrades are necessary to accommodate the increased weight of the core stage along with ground support and transportation equipment aboard the modified barge Pegasus. Exploration Ground Systems is overseeing the upgrades to the turn basin wharf. Photo credit: NASA/Kim Shiflett

JUNE

When the core stage for NASA's massive Space Launch System (SLS) rocket departs the Michoud Assembly Facility in New Orleans, it will be shipped by barge to the Launch Complex 39 turn basin wharf at Kennedy Space Center to be integrated with other hardware in preparation for its first launch, known as Exploration Mission-1. Modifications are underway to upgrade the wharf and prepare for the arrival of the core stage.

Located just across the street from the iconic Vehicle Assembly Building (VAB), the dock area that was used for arrival and offloading of space shuttle external tanks is getting a makeover to accommodate the core stage when it arrives aboard NASA's modified barge Pegasus. The 212-foot-long core stage, which is more than 50 feet longer than the space shuttle tank, serves as the structural backbone of the rocket and includes the SLS propellant tanks and four RS-25 engines. When Pegasus arrives at Kennedy's turn basin, it will be carrying the core stage and all its ground support and transportation equipment -- cargo that is more than 600,000 pounds heavier than Pegasus transported for the space shuttle.

"The turn basin is undergoing significant structural modifications and electrical upgrades to be ready for the core stage and Pegasus barge," said Jimmy Rogers, a project manager with Kennedy's Exploration Ground Systems (EGS). "Analysis was performed on how Pegasus was going to be moored at the wharf to offset wind load scenarios. The barge's length was increased to 310 feet long to meet barge-to-dock interface requirements for the core stage."

Read the complete story at https://www.nasa.gov/feature/turn-basin-prepped-for-space-launch-system-core-stage-arrival.

The core stage forward skirt umbilical is installed on the mobile launcher tower at Kennedy Space Center. The mobile launcher is designed to support the assembly, testing and checkout of the agency's Space Launch System rocket and the Orion spacecraft. Photo credit: NASA/Kim Shiflett

CORE STAGE FORWARD SKIRT UMBILICAL INSTALLED ON MOBILE LAUNCHER

JULY

The Core Stage Forward Skirt Umbilical (CSFSU) was installed on the tower of the mobile launcher at Kennedy Space Center, to prepare for the first launch of the agency's Space Launch System (SLS) rocket with the Orion spacecraft atop.

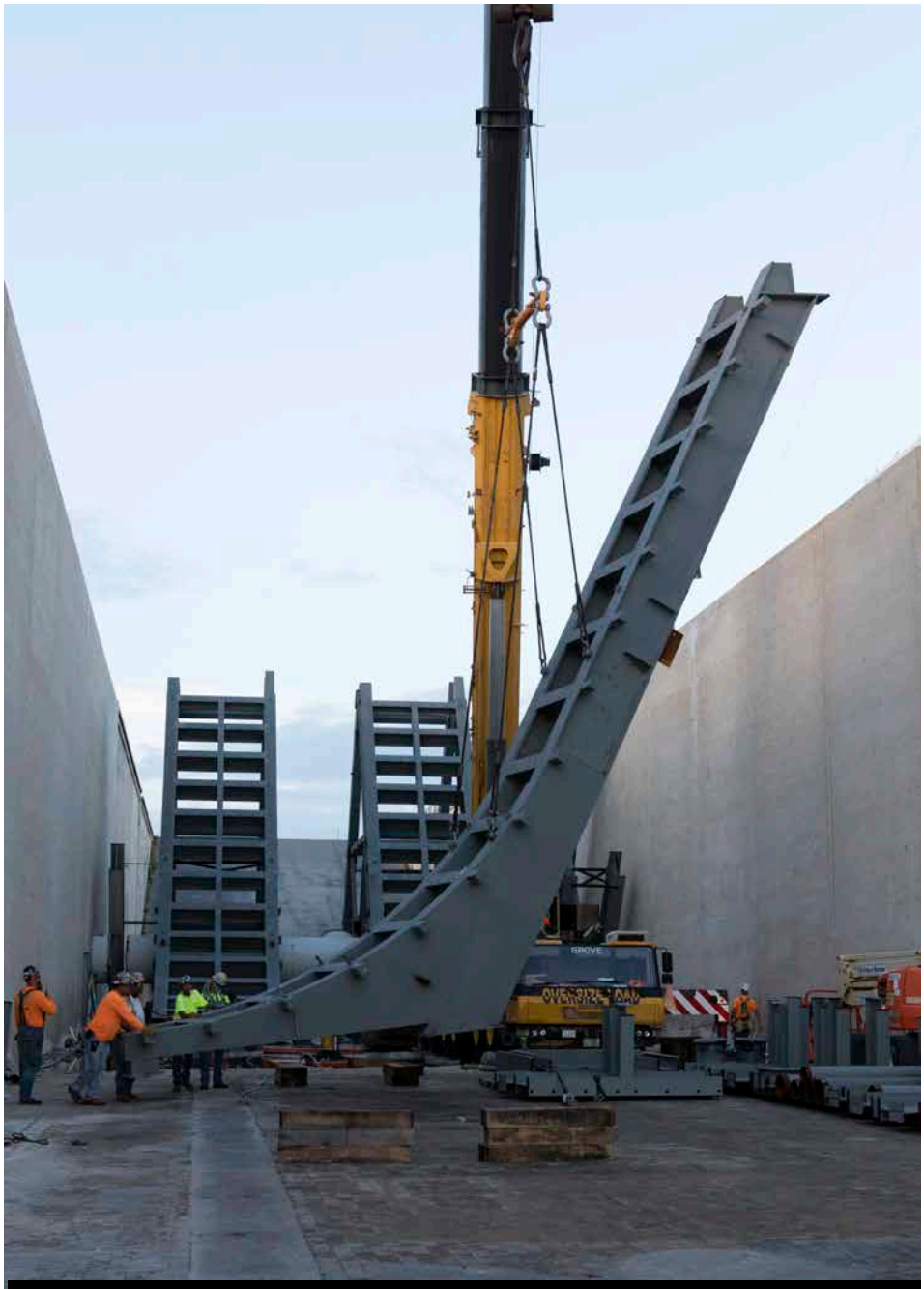
The mobile launcher tower will be equipped with a number of lines, called umbilicals, which will connect to the SLS and Orion spacecraft and provide commodities during processing and preparation for launch of Exploration Mission-1. Cranes and rigging were used to lift the CSFSU and install it at about the 220-foot level on the tower. The CSFSU will swing into position to provide connections to the core stage forward skirt of the SLS rocket, and then swing away before launch. Its main purpose is to provide conditioned air and gaseous nitrogen to the SLS core stage forward skirt cavity.

Exploration Ground Systems is overseeing installation of the umbilicals on the tower.

INSTALLATION BEGINS ON NEW FLAME DEFLECTOR AT LAUNCH PAD 39B

JULY

A crane is used to move one of the large segments of the support hardware for a new flame deflector and position it in the flame trench at Launch Pad 39B at NASA's Kennedy Space Center in Florida. The new flame deflector will be positioned about six feet south of the shuttle-era flame deflector's position. During liftoff of NASA's Space Launch System, the rocket's flame and energy will be diverted to the north side of the flame trench. The north side of the deflector will be protected by a NASA standard coating. The south side of the deflector will not be slanted and will have no lining. The new design will provide easier access for inspection, maintenance and repair. The Exploration Ground Systems program at Kennedy is managing the installation of the flame deflector for Exploration Mission-1, deep space missions, and NASA's Journey to Mars.



A crane is used to move one of the large segments of the support hardware for a new flame deflector and position it in the flame trench at Launch Pad 39B at NASA's Kennedy Space Center in Florida. Photo credit: NASA

A flatbed truck carrying one of two new service platforms for NASA's Space Launch System booster engines arrives at the Vehicle Assembly Building at Kennedy Space Center. Photo credit: NASA/Bill White

AUGUST

SERVICE PLATFORMS ARRIVE FOR SPACE LAUNCH SYSTEM BOOSTER ENGINES

New service platforms for NASA's Space Launch System (SLS) booster engines arrived at Kennedy Space Center. The platforms were transported on two flatbed trucks from fabricator Met-Con Inc. in Cocoa, Florida. They were offloaded and stored inside the Vehicle Assembly Building.

The platforms will be used for processing and checkout of the engines for the SLS' twin five-segment solid rocket boosters for Exploration Mission-1 (EM-1). The boosters, in combination with the rocket's four RS-25 engines, will produce more than 8 million pounds of thrust at liftoff.

The first SLS mission, EM-1, will launch an uncrewed Orion spacecraft to a stable orbit beyond the Moon and bring it back to Earth for a splashdown in the Pacific Ocean. The mission will demonstrate the integrated system performance of the rocket, Orion spacecraft and ground support teams prior to a crewed flight.

SEPTEMBER

Mist or vapor is visible Sept. 26, 2017, as a Praxair truck slowly transfers its load of liquid oxygen (LO2) into a giant storage sphere at the northwest corner of Launch Pad 39B at Kennedy Space Center. Photo credit: NASA/Kim Shiflett

LIQUID OXYGEN TANKING OPERATIONS BEGIN AT LAUNCH PAD 39B

The first major integrated operation at Launch Pad 39B at Kennedy Space Center began with the initial tanking of a cryogenic fuel into a giant sphere at the northwest corner of the pad. The tanking operation is one of the steps needed to bring the center closer to supporting the launch of the agency's Orion spacecraft atop the Space Launch System rocket on its first uncrewed test flight.

"When I think of launch operations, there are distinct pictures that come to mind," said NASA Launch Director Charlie Blackwell-Thompson. "One of them is during the tanking operations as the cryogenic propellants are loaded into the Space Launch System rocket."

Several Praxair trucks arrived at the center and offloaded their liquid oxygen, or LO2, slowly, one at a time, into the cryogenic sphere to gradually chill it down from normal temperature to about negative 298 degrees Fahrenheit. Praxair, of Danbury, Connecticut, is the company that provides the agency with liquid oxygen and liquid hydrogen.

Another wave of trucks arrived and offloaded their LO2 all at the same time. During the next several months, trucks will continue to arrive from Praxair and offload about 40,000 gallons of fuel two days per week into the sphere that can hold about 900,000 gallons of liquid oxygen.

The procedure to fill the liquid hydrogen storage sphere began in December and will be completed in the same way. When both tanks are filled to about halfway, engineers in a firing room in the Launch Control Center will perform pressurization tests. Additional tests will be performed with the mobile launcher around mid-2018. The cryogenic fuels will remain in the tanks.

Blackwell-Thompson said it is not uncommon during tanking to see vapors and mist in the cryo storage area and near the vehicle. She got a preview, when the trucks offloaded the first round of LO2 and once again, cryo vapors were visible. Because some of the liquid oxygen boils off during tanking, additional LO2 is required.

"This is a very important step in our path to launch, and we are thrilled to have cryo propellant return to the pad," Blackwell-Thompson said.

Exploration Ground Systems is preparing the pad for the launch of Exploration Mission-1, deep space missions and the Journey to Mars.

SEPTEMBER

The Mobile Launcher, Launch Control Center, Vehicle Assembly Building and Launch Complex 39 surrounding areas are seen during an aerial survey of Kennedy Space Center on September 12, 2017. The survey was performed to identify structures and facilities that may have sustained damage from Hurricane Irma as the storm passed Kennedy on September 10, 2017. NASA closed the center ahead of the storm's onset and only a small team of specialists, known as the Rideout Team, was on the center as the storm approached and passed. Photo credit: NASA/Bill White

HURRICANE IRMA PREP AND RECOVERY

After reaching the Florida peninsula and traveling up the center of the state, Hurricane Irma devastated the Space Coast region of Florida on Sept. 10, 2017. Exploration Ground Systems (EGS) took many precautions to prepare for the storm. Fortunately, Hurricane Irma did only minor damage to EGS worksites. Overall, EGS program operations were delayed two weeks due to the impact of the storm. The program is continuing its development of the critical infrastructure needed to support NASA's Journey to Mars and deep space exploration goals.

Two heavy-lift cranes are used to tilt and lower the Orion crew access arm onto a work stand in a storage location at Kennedy Space Center on Oct. 27, 2017. The access arm was transported from Precision Fabricating and Cleaning in Cocoa, Florida. The crew access arm will be located at about the 274-foot level on the mobile launcher tower. Exploration Ground Systems is overseeing installation of umbilicals and launch accessories on the tower. Photo credit: NASA/Kim Shiflett

OCTOBER

ORION CREW ACCESS ARM ARRIVES AT KENNEDY SPACE CENTER

When astronauts depart for missions to deep space, they will cross the Crew Access Arm about 300 feet above the ground to board their spacecraft. The access arm was delivered to Kennedy Space Center on Oct. 17, 2017, to install on the mobile launcher in preparation for the first flight of the Space Launch System rocket, or SLS, and the Orion spacecraft.

The SLS will be the largest rocket in the world and will be stacked with Orion inside the historic Vehicle Assembly Building, or VAB, on the mobile launcher and rolled out to the pad prior to launch. The access arm will be one of 11 connection points to the rocket and spacecraft from the tower on the mobile launcher. After technicians install the arm, the mobile launcher will be rolled into the VAB for validation and verification tests.

For the first launch without crew, the access arm will provide a bridge to Orion for personnel and equipment entering the spacecraft during processing and prelaunch integrated testing while in the VAB and at the launch site.

The arm is made up of two major components: the truss assembly and the environmental enclosure, or the white room. The arm will provide entry and emergency egress for astronauts and technicians into the Orion spacecraft. On future human missions, astronauts outfitted with newly designed space suits will enter the white room, where they will be assisted by technicians into the spacecraft for launch. The arm will retract before launch, and the other connections will release at liftoff, allowing the rocket and spacecraft to safely clear the launch pad.

NOVEMBER

A heavy-load transport truck carries the Orion crew access arm to the mobile launcher at Kennedy Space Center on Nov. 11, 2017. Photo credit: NASA/Frank Michaux

ORION CREW ACCESS ARM TRANSPORTED TO MOBILE LAUNCHER

A heavy-load transport truck carrying the Orion crew access arm nears the mobile launcher (ML) at Kennedy Space Center on Nov. 11, 2017. The crew access arm will be installed at about the 274-foot level on the mobile launcher tower. It will rotate from its retracted position and interface with the Orion crew hatch location to provide entry to the Orion crew module. Exploration Ground Systems is overseeing installation of umbilicals and launch accessories on the ML tower to prepare for Exploration Mission-1. Photo credit: NASA/Frank Michaux

FLIGHT HARDWARE ARRIVAL MARKS HISTORIC MILESTONE

NOVEMBER

Packed inside its canister, the Interim Cryogenic Propulsion Stage (ICPS) stands inside the high bay of the Space Station Processing Facility at NASA's Kennedy Space Center in Florida. The ICPS is the first integrated piece of flight hardware to arrive in preparation for the uncrewed Exploration Mission-1. With the Orion attached, the ICPS sits atop the Space Launch System rocket and will provide the spacecraft with the additional thrust needed to travel tens of thousands of miles beyond the Moon.

Packed inside its canister, the Interim Cryogenic Propulsion Stage (ICPS) stands inside the high bay of the Space Station Processing Facility at NASA's Kennedy Space Center in Florida. Photo credit: NASA/Bill White

DECEMBER

EXPLORATION GROUND SYSTEMS MAKES A SPLASH AT LAUNCH PAD 39B

About 450,000 gallons of water flowed at high speed from a holding tank through new and modified piping and valves, the flame trench, flame deflector nozzles and mobile launcher interface risers during a wet flow test at Launch Pad 39B at Kennedy Space Center. At peak flow, the water reached about 100 feet in the air above the pad surface. The test was a milestone to confirm and baseline the performance of the Ignition Overpressure/Sound Suppression system. During launch of NASA's Space Launch System rocket and Orion spacecraft, the high-speed water flow will help protect the vehicle from the extreme acoustic and temperature environment during ignition and liftoff. Photo credit: NASA/Kim Shiflett

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