

National Aeronautics and Space Administration



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John C. Stennis Space Center

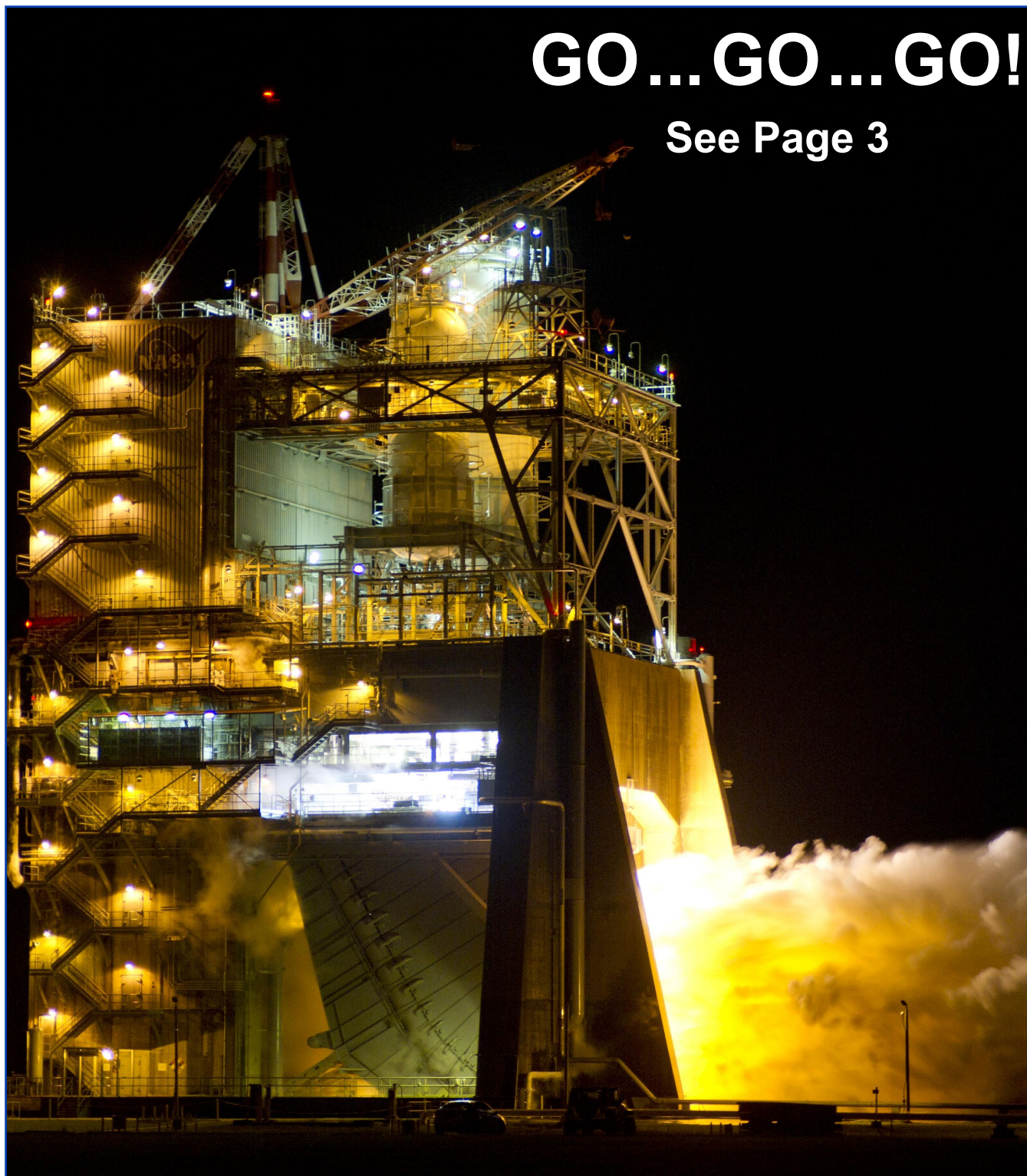
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December 2019

GO...GO...GO!

See Page 3



This time of year is delightful, especially on those just-cool-enough evenings when you can sit by the bayou on a clear night and enjoy a glass of eggnog – of the secret recipe variety, of course. Ark! That is just what I was doing recently, yuletide music playing on the porch radio, when I noticed the full Moon in the sky.

The thought occurred to me – it was almost exactly 47 years ago that the last human stepped off of that lunar surface to climb back into his spacecraft. Astronauts Gene Cernan and Harrison Schmitt explored the Moon surface during the Apollo 17 mission in December 1972. Their mission was powered by the Saturn V S-IC-12 first stage, tested at Stennis Space Center on Nov. 3, 1969, and the Saturn V S-II-12 second stage, tested at Stennis on March 4, 1970.

Cernan took human's final step off the Moon – pending NASA's Artemis Program return – on Dec. 13. Prior to that, he and Schmitt paused for reflection. Understanding the mission was the last scheduled for the Moon, Cernan noted the significance of the Apollo Program that landed six pairs of astronauts on the lunar surface from July 1969 to December 1972.

“It has opened for us – ‘for us’ being the world – a challenge of the future,” he said. “The door is now cracked, but the promise of the future lies in the young people, not just in America, but the young people of the world in so many countries.”

The astronauts then picked up a lunar rock sample composed of various fragments as a symbol of hope that humans around the world could live in harmony. Cernan suggested that pieces of the rock could be shared with other countries, and that is exactly what happened. With the return of Apollo 17, fragments of the so-called Goodwill Rock were sent around the country and the world, along with a wish that people of Earth would work together not just to explore space but to promote peace at home.

As I thought of the Goodwill Rock, a yuletide song proclaiming peace on Earth and good will to all began to play on the radio, the words lifting into the Moon-bright, star-scattered sky. It was just a perfect moment for this wonderful season of reflection and hope. May it spread to good humans – and gators – everywhere.

Happy holidays – and pass the eggnog, please!



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Contact info – (phone) 228-688-3749; (email) ssc-pao@mail.nasa.gov; (mail) NASA OFFICE OF COMMUNICATIONS, Attn: LAGNIAPPE, Mail code IA00, Building 1100 Room 304, Stennis Space Center, MS 39529

Managing Editor – Valerie Buckingham

Editor – Lacy Thompson

Staff Photographer – Danny Nowlin



NASA's MOON to MARS MISSION

GO...
GO...
GO!

Why does NASA test before flying?

One day in the sooner-rather-than-later future, people across the nation will rearrange daily schedules to witness a long-anticipated event – the maiden launch of NASA's new Space Launch System (SLS) rocket.

A pair of solid rocket boosters and four RS-25 engines will fire at a south Florida launchpad to generate more than 8 million pounds of thrust, lifting the 321-foot SLS rocket into the sky on its way to the Moon and back.

The launch will herald the beginning of a new great era of space exploration, one set on establishing a sustainable presence on the Moon and placing human footprints on Mars.

In no small part, success of the new era rests on hard work provided by Stennis Space Center, which is testing the rocket engines and SLS core stage that will power the new rocket to unprecedented destinations.

Lagniappe is featuring a series of articles under the "Go ... Go ... Go!" heading that detail aspects of NASA's next step into deep space and Stennis' role in making such missions possible. The following represents the third installment.

On April 12, 1981, a pair of American astronauts – Robert Crippen and John Young – sat in the cockpit of space shuttle Columbia on a Florida launchpad, awaiting launch countdown. The mission was Crippen's first chance to fly into space. Young had flown on four prior missions, including Apollo 16, which had carried him to the surface of the Moon. However, he had not experienced what was about to happen.

Twenty years after Yuri Gagarin became the first human to fly to space on April 12, 1961, Crippen and Young were being launched to the same realm. If the mission succeeded, it would mark the first time a winged craft had reached space. It also would mark the first time astronauts had flown on a U.S. spacecraft that had not been tested first with a crewless flight.

Columbia's STS-1 mission would be the test flight.

Why NASA tests

NASA's new SLS rocket will undergo a gamut of tests prior to a human mission. Engines and systems will be tested individually before the SLS flight core stage is delivered to Stennis. At Stennis, the stage will be installed on the B-2 Test Stand and undergo Green

Run testing, the first test of all stage systems in an integrated way, just as they must perform in flight.

After Green Run, the core stage will be mated with its other SLS stages and the Orion spacecraft – all of which will have undergone their own tests – to fly a crewless Artemis I test mission. The mission will be the first flight of NASA's Artemis Program. NASA plans to send humans, including the first woman, to the Moon on the Artemis III mission.

NASA conducts such extensive tests – both on the ground and with crewless missions – for key reasons:

- **Verify and validate design of the engine/system.** Designs are based on models. Testing ensures the models are valid. The SLS design is also based on heritage systems, but much has changed since the Apollo era. Testing will demonstrate if the updated SLS design will perform as expected.
- **Collect performance data/test the limits.** Engineers and operators want to know as much as possible about how a particular engine or rocket system operates. The knowledge enables them to maximize the performance of the unit and to anticipate issues that may arise during a mission.
- **Identify and address relevant issues earlier rather than later, perhaps during a costly mission or one carrying a crew.** Loss of a mission due to engine/system failure can have a significant impact, particularly if crew members are involved. Testing prior to flight offers a margin of safety for engines/systems to fly.

What NASA tests

When it comes to what NASA actually tests, the short answer is – everything and anything. "Everything" encompasses a range of items. If an engine or system is headed to space, it is tested. If a change is made to an engine or system – perhaps an engine component is upgraded or a system function is modified – it is tested. Sometimes, a change to an integrated system will cause unanticipated problems elsewhere in the system. Testing ensures that is not the case.

As for "anything," operators want to know how an engine or system operates in various conditions. In testing, they can introduce anomalies to learn exactly how the engine or system will respond.

How NASA tests

NASA conducts such tests as closely as possible to the way an engine or system has to fly. For instance, when Stennis tests RS-25 engines, they install the engine on a test stand and operate it at thrust levels required during a flight – and runs the test for the same length of time it will have to operate during a flight.

When it comes to the SLS core stage, the same process will hold. After installing the stage on the B-2 stand, NASA will test its integrated systems, then fire its four RS-25 engines simultaneously, just as during an actual launch.

Why NASA tests at Stennis

Stennis is a logical place for testing such large rocket engines and systems. It has the perfect location, the specialized facilities and the proven test teams. Most of all, it has more than 50 years experience in testing engines and systems to power the nation's space program. This is best illustrated in the story of that first space shuttle launch. Some questioned the wisdom of not scheduling a crewless test flight, but Crippen and Young had good reason for mission confidence.

The previous July, the pair had visited Stennis, where the integrated shuttle propulsion system was being run through a series of ground tests in preparation for the April flight. The pair commended the work of the site for its comprehensive testing. "When it comes to making an engine work properly and getting all the bugs out of it, there's nothing like doing it in a test and that's what this place is all about," Young said.

Columbia launched on April 12, 1981 at exactly 6 a.m. CST. Its two-day mission was a resounding success, and it took but a month for the two astronauts to return to Stennis and thank the employees. "You can't do this kind of program without running an extensive test program on it, and this effort that you contributed is why John and I got to sit back and ride," Crippen said. "We couldn't even make it look hard."

Crippen and Young understood – the hard testing work had been done. Entrusted with the success of the shuttle and the safety of its astronauts, Stennis had delivered with a rigorous test series that some later characterized as the site's "finest hour" and that enabled a flawless maiden mission.

NASA's MOON to MARS MISSION

Stennis set for SLS core stage after Stennis completes sitewide stress test

The Stennis Space Center stage is fully set for NASA's Space Launch System (SLS) core stage following a successful – and comprehensive – stress test of critical site facilities and personnel Dec. 13.

For 24 hours, midnight to midnight, Stennis test crews conducted operations to demonstrate all is ready for testing the new rocket stage. The exercise involved the B-2 Test Stand – where the core stage will be installed and tested – as well as high-pressure water, high-pressure gas and E Test Complex support facilities. The exercise included typical pre-test activities during a run-up to a simulated afternoon core stage “test” Dec. 14, followed by usual post-test activities.

“This was a chance to show we could perform as needed on test days, both in terms of equipment and personnel,” B-2 Project Manager Barry Robinson said. “It helped us verify and validate all needed systems, as well as fine-tune test day operating procedures and personnel requirements.”

The exercise met a list of successful criteria involving the flow of gases and propellants, the operation of water pumps and electrical generators, and the ability of work crews to effectively communicate across the sprawling test complex area.

Some operations – such as the flow of gases and propellants – were limited. However, others were conducted for the full 24 hours, including the operation of large generators to power the B-2 stand during the delivery of specialized gases by truck and the simultaneous operation of all 11 high-pressure pumps supplying water flow to the stand.

Tests already had been conducted on various individual systems. “However, you don't know what you don't know, so we wanted to conduct a comprehensive test to make sure all was ready, including the work teams,” Robinson said. “The test was designed to help us identify any issues and address them now, before the test article arrives and is installed.”

No major issues were identified, clearing the way for testing the SLS stage in 2020. NASA is building SLS as the world's most powerful rocket. It will power Artemis Program missions that will carry



(Above photo) Tank trucks offload liquid gases at the Stennis high pressure gas facility during a test operations stress test Dec. 13.

(Right photo) Water flows into the B-2 Test Stand flame deflector Dec. 13 during a simulated Space Launch System core stage test.

humans, including the first woman, to the Moon and, eventually, missions to Mars.

The rocket's core stage stands 212 feet tall, with a diameter of 27.6 feet. It features a pair of propellant tanks to hold more than 730,000 pounds of liquid hydrogen and liquid oxygen. It is equipped with four RS-25 engines that will provide more than 2 million pounds of combined thrust at liftoff.

NASA spent several years modifying the B-2 stand for the upcoming test project. The so-called Green Run effort will be the first comprehensive test of all SLS core stage systems and will conclude with a firing of all four RS-25 engines, just as during a launch.

Prior to Green Run, however, Stennis had to complete its own comprehensive test of systems. At the B-2 stand, that meant performing gas and propellant flows through piping systems, operating the environmental control system as needed and demonstrating test-day procedures. Among other things, this involved maintaining full liquid oxygen and liquid hydrogen replenish flows for more than three-and-a-half hours.

At the high-pressure gas facility, it meant demonstrating the ability to flow needed gases for an extended period, validating system models, evaluating the effect of recent facility updates and demonstrating personnel capabilities. Work included operating a helium compressor for 18 hours, achieving maximum system pressure levels and running a liquid nitrogen pump for a six-hour period.

At the high-pressure water facility, crews worked to demonstrate pump and generator capabilities, which included providing generator power for the entire 24-hour period and running the water pumps for a 10-hour stretch.

Meanwhile, the E Test Complex used the sitewide exercise to demonstrate its ability to contribute needed gas, which included flowing gaseous nitrogen for an 11-hour period.

Engineering and Test Directorate leaders were pleased with the effort. “Stennis teams have worked hard to prepare for core stage testing,” Robinson said. “The sitewide exercise demonstrated the good results of those efforts.”



NASA's MOON to MARS MISSION

Stennis test crews simulate core stage test day during sitewide stress test



A Stennis Space Center sitewide stress test Dec. 13 focused on simulating operations that will be needed during Space Launch System (SLS) core stage testing in 2020. Stennis will test the flight core stage of the new SLS rocket prior to its launch on an uncrewed Artemis I mission. Testing will include firing the stage's four RS-25 engines simultaneously, as during an actual launch. The Dec. 13 exercise simulated operations leading up to and through a core stage test, as well as post-test activities. The 24-hour exercise involved crews across Stennis, including at the high pressure water facility (top photos), which will provide needed generator power and water flow to the B-2 Test Stand during testing; at the E Test Complex (bottom left photo), which will provide and monitor some of the high-pressure gases needed during test operations; and at the B Test Complex Test Control Center (bottom right photo), which will direct and monitor test day operations.



NASA's MOON to MARS MISSION

NASA marks assembly of Space Launch System stage with Artemis Day event

On Dec. 9, NASA Administrator Jim Bridenstine showed off the Space Launch System (SLS) liquid-fueled rocket stage that will send the first Artemis mission to space. The core stage, built at NASA's Michoud Assembly Facility in New Orleans, is the largest NASA has produced since the Apollo Program.

NASA and the Michoud team will shortly send the first fully assembled, 212-foot-tall core stage to the agency's Stennis Space Center near Bay St. Louis, Mississippi aboard the Pegasus barge for final tests. Following activities at Michoud on Dec. 9, guests and media traveled to Stennis the following day for facility tours and briefings.

Surrounded by key NASA personnel and officials from Congress, as well as state and regional government, Bridenstine said the milestone marked a new chapter in the Artemis story as the agency works to answer the presidential charge to land the first woman and the next man on the Moon by 2024.

"The completion of the SLS core stage is a major milestone and a testament to American enterprise and ingenuity," Bridenstine said. "With more than 1,100 large and small businesses in 44 states contributing to the design and assembly, the SLS rocket will empower America to achieve the Artemis Program's goal of landing the first woman and next man on the Moon by 2024."

Artemis I will launch the SLS rocket and an uncrewed Orion spacecraft around the Moon to test the systems of both the rocket and the spacecraft. The core stage Green Run tests at Stennis will pave the way for successful Moon missions, and it is the final test series ahead of the Artemis I launch. The series will mark the first full test of the entire SLS core stage, including the stage's extensive propulsion, avionics and flight software systems.

With a design featuring some of the most sophisticated hardware ever built for spaceflight, the core stage is the powerhouse of the SLS rocket. The five major structures – the forward skirt, liquid oxygen tank, intertank, liquid hydrogen tank and engine section – that make

up the stage are manufactured and assembled at Michoud. The 43-acre facility includes state-of-the-art welding and manufacturing tools to produce the huge, 27.6-foot-in-diameter tanks and barrels.

"Earlier this year, NASA revised its assembly plan to connect the stage horizontally rather than vertically," SLS Program Manager John Honeycutt said. "By doing so, NASA advanced its timeline so that our teams could meet our goal to complete assembly on the core stage by the end of the year. It was great to have for employees, stakeholders and the public to join us in the factory to mark the occasion."

Assembly and integration of the massive stage and its four RS-25 engines have been a collaborative, multistep process for NASA and its partners Boeing, the core stage lead contractor, and Aerojet Rocketdyne, the RS-25 engines lead contractor.

Artemis Day welcomed media and social media influencers for a rare glimpse inside the Michoud factory. They saw not only the integrated core stage but also large structures that will be connected to form the core stage for Artemis II, the first mission to send astronauts to lunar orbit, as well as components for Artemis III, the mission that will put humans back on the lunar surface. Attendees participated in a full day of events and activities, including extended tours of the facility and two discussion panels with engineers and technicians building the hardware for NASA's next-generation Moon missions. "Michoud is proud of its nearly 60 year history in manufacturing and assembling large vehicles and components for our nation's space program," said Robert Champion, director of NASA's Michoud Assembly Facility.

SLS is the only rocket that can send Orion, astronauts and supplies to the Moon on a single mission. SLS, Orion, and the Gateway in orbit around the Moon, are NASA's backbone for deep space exploration and the Artemis Program.

For more on NASA's SLS, visit: <https://www.nasa.gov/sls>

(Right photo) NASA Administrator Jim Bridenstine gives remarks on NASA's Artemis Program on Dec. 9 in front of the core stage for the new Space Launch System rocket at Michoud Assembly Facility in New Orleans.

(Bottom left photo) NASA Administrator Jim Bridenstine, joined by astronaut candidates Matthew Dominick and Jasmin Moghbeli, NASA's associate administrator for communications Bettina Inclin and Michoud Assembly Facility Director Robert Champion, views the fully assembled core stage for the agency's Space Launch System rocket Dec. 9.

(Bottom right photo) Mark Nappi (left), director of Space Launch System core stage testing for The Boeing Company, and Maury Vander, chief of the Test Operations Division in the Engineering and Test Directorate at Stennis Space Center, talk with media members during Artemis Day activities at Stennis on Dec. 10.



NASA's MOON to MARS MISSION

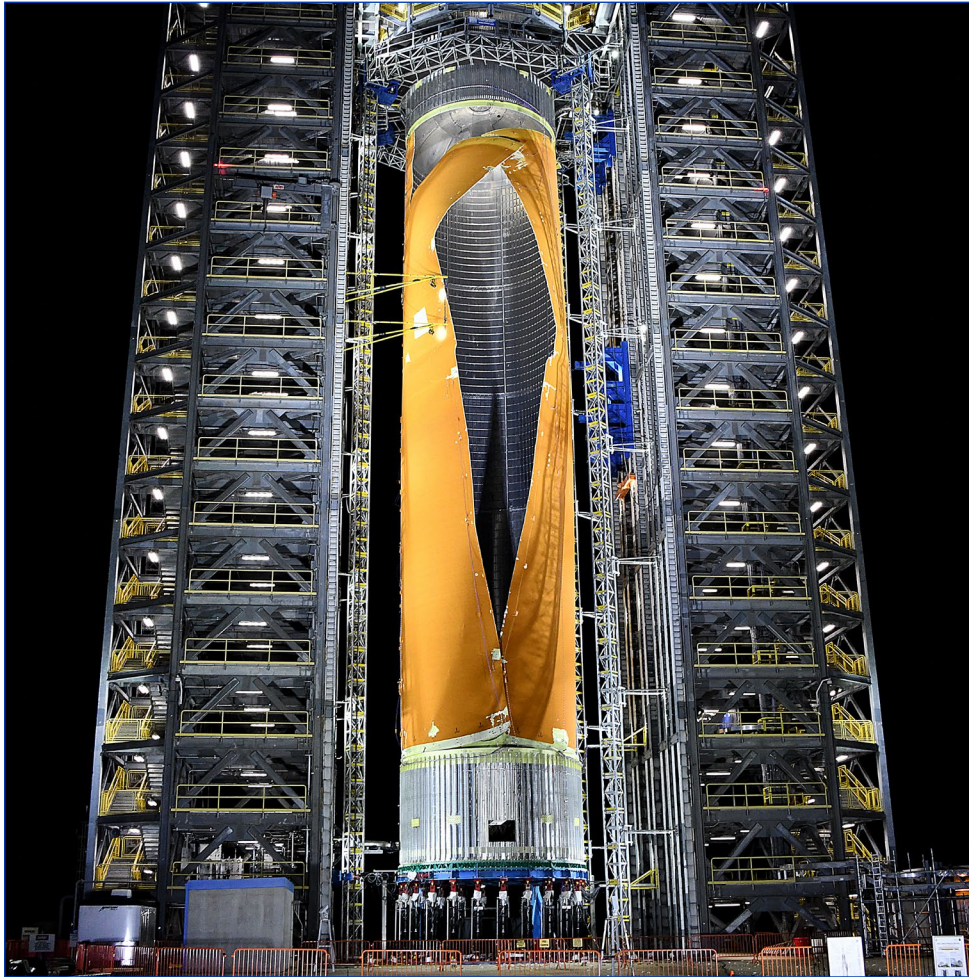
Key officials, media visit Michoud and Stennis sites for Artemis Day activities



Key officials (above photo) and social influencers (bottom right photo) stand at the B-2 Test Stand at Stennis Space Center during Artemis Day activities at the site Dec. 10. NASA hosted the officials and media members to mark the assembly of the core stage for its new Space Launch System rocket.

(Top center photo) Maury Vander, chief of the Test Operations Division in the Engineering and Test Directorate at Stennis, points out aspects of the modified B-2 Test Stand, where the Space Launch System core stage will be installed and tested prior to its first flight, to visiting media members Dec. 10.

NASA Administrator Jim Bridenstine leads a panel discussion with key NASA subject matter experts during Artemis Day at NASA's Michoud Assembly Facility in New Orleans on Dec. 9, 2019.



NASA push SLS test tank's limits

Engineers at NASA's Marshall Space Flight Center in Huntsville, Alabama, on Dec. 5 deliberately pushed the world's largest rocket fuel tank beyond its design limits to really understand its breaking point. The test version of the Space Launch System rocket's liquid hydrogen tank withstood more than 260 percent of expected flight loads over five hours before engineers detected a buckling point, which then ruptured, as shown in the accompanying image. The test version of the tank aced earlier tests, certifying it for use, by withstanding forces expected at engine thrust levels planned for lunar missions and showing no signs of cracks, buckling or breaking. The test on Dec. 5 pushed the tank to the limits by exposing it to higher forces that caused it to break as engineers predicted. The test results will provide rocket designers with valuable information that could be used to make the SLS tanks more lightweight and allow the rocket to send even more cargo to space. The results also will inform the designs of other government and commercial rockets. For full story, visit: <https://go.usa.gov/xpVRp>.

NASA in the News

NASA releases *Earth at Night* ebook

Earth has many stories to tell, even in the dark of night. *Earth at Night*, NASA's new 200-page ebook, is now available online and includes more than 150 images of our planet in darkness as captured from space by Earth-observing satellites and astronauts on the International Space Station over the past 25 years. The images reveal how human activity and natural phenomena light up the darkness around the world, depicting the intricate structure of cities, wildfires and volcanoes raging, auroras dancing across the polar skies, moonlight reflecting off snow and deserts, and other dramatic earthly scenes. The book also tells how scientists use these observations to study the changing planet and aid decision makers in such areas as sustainable energy use and disaster response. NASA brings together technology, science, and unique Earth observations to provide societal benefits and strengthen the nation. The agency makes its observations freely available to everyone for use in developing solutions to important global issues. For more on NASA's Earth science programs, visit: <https://www.nasa.gov/earth>. To access the new ebook, visit: <https://go.usa.gov/xppmP>.

Mission revealing new details about Sun

The Sun is revealing itself in dramatic detail and shedding light on how other stars may form and behave throughout the universe – all thanks to NASA's Parker Solar Probe. The spacecraft is enduring scorching temperatures to gather data, being shared for the first time in four new papers that illuminate previously unknown and only-theorized characteristics of the volatile celestial neighbor. The information about how the Sun constantly ejects material and energy will help scientists to rewrite the models they use to understand and predict the space weather around Earth and to understand the process by which stars are created and evolve. This information will be vital to protecting astronauts and technology in space. The four papers, now available online from the journal *Nature*, describe Parker's unprecedented near-Sun observations through two record-breaking close flybys. Data from Parker Solar Probe's first two solar encounters are available online at: <https://go.nasa.gov/34VPMGK>. For more about Parker, visit: <https://www.nasa.gov/parker>. Imagery from the Parker Solar Probe mission is available at: <https://svs.gsfc.nasa.gov/13484>.

Stennis 2019 review – year after year, some fundamental things apply

In one scene of the great movie classic *Casablanca*, Dooley Wilson croons a love ballad that includes the lines – “The fundamental things apply/As time goes by.”

The lines serve as a fitting summary of 2019 at Stennis Space Center. The past year was both a testament – and added chapter – to the site’s long history of propulsion testing excellence, as a brief overview shows:

- Following a monthlong government furlough to begin the year, Stennis wasted no time resuming RS-25 engine testing for NASA’s new Space Launch System (SLS), conducting the first test of 2019 on Feb. 13. Two weeks later, it marked a milestone by powering the RS-25 to its highest operating level for longer than any previous hot fire at that thrust level. (In March, testing of RS-25 engines at Stennis would be featured in a new episode – *Rise of the Rockets* – of the Public Broadcasting System’s *NOVA* program.)
- On April 4, NASA concluded 51 months of RS-25 testing that demonstrated the engines can perform at the higher power level needed for SLS rocket. The test marked another milestone, signaling that all 16 RS-25 flight controllers and engines for the first four SLS missions were tested and ready to fly. In mid-summer, NASA would announce those early missions would fly as part of the new Artemis Program, designed to return humans, including the first woman, to the Moon.
- In late April, an integrated test team at Stennis received the prestigious Stellar Award from the Rotary National Award for Space Achievement Foundation for its historic AR-22 test series. The blended team of federal and commercial engineers and operators conducted 10 AR-22 tests in 10 days on the A-1 Test Stand at Stennis in the summer of 2018, an unprecedented large engine testing achievement.
- May saw delivery of the SLS core stage pathfinder to the B-2 Test Stand at Stennis. The pathfinder – a size-and-weight replica of the SLS flight core stage – allowed Stennis crews to practice various handling procedures. The exercises included successfully lifting and installing the pathfinder on the B-2 stand, just as must be done with the flight core stage. Later in the year, Stennis also conducted a sitewide stress test to demonstrate it is fully ready for core stage testing. **(See page 3)**
- In June, Relativity Space announced it was partnering with NASA to expand its robotic 3D-printing rocket facilities at Stennis. The company already had partnered with Stennis for development of testing facilities at the site.
- On July 1, outgoing Gov. Phil Bryant announced launch



On Feb. 13, about two weeks after a monthlong government furlough ended, NASA conducted the first RS-25 engine test of 2019 on the A-1 Test Stand at Stennis Space Center.

of a new economic development Space Initiative, designed to target and attract new space companies to the state.

- On July 25, NASA officially announced it would proceed with Green Run testing of the SLS core stage prior to its first flight. The announcement set the stage for delivery and testing of the stage in 2020.
- At the end of September, the U.S. Air Force Research Laboratory concluded testing of a state-of-the-art rocket engine preburner on the E-1 Test Stand at Stennis. The successful testing culminated two decades of research into oxygen-rich staged combustion for the laboratory.

As in previous years, Stennis achievement was not limited to propulsion testing. The Advanced Technology and Technology Transfer Branch continued efforts to introduce Stennis-developed technology into the wider market and to the public. The Office of Communications hosted a variety of events across the region to share the NASA/Stennis story and inspire support for agency missions. And the Office of STEM Engagement continued to encourage and inspire students of all ages to pursue studies and careers in science, technology, engineering and mathematics fields.

Onsite, Stennis continued to engage employees in areas of diversity and inclusion. The site also hosted a range of visitors

during the year, including student groups, congressional representatives, NASA officials, astronauts and business leaders.

As 2020 approaches, a new year – an added chapter, so to speak – of such work and efforts already is planned. The year promises to be historic, especially in the area of propulsion as Stennis tests the SLS core stage in preparation for its maiden Artemis I flight and resumes RS-25 engine testing for future SLS missions.

That fact comes as no surprise. As Wilson sang in *Casablanca*, on some things one can surely rely – “No matter what the future brings/As time goes by.”



(Top left photo) The Space Launch System (SLS) core stage Pathfinder – a replica of the actual core stage – sits on the B-2 Test Stand tarmac at Stennis after it was rolled out of the Pegasus barge May 3. Stennis used the Pathfinder to help confirm all is ready for arrival of the actual SLS flight core stage.

(Bottom left photo) A practice lift of a Space Launch System core stage "spider" component offers a panoramic view of the A Test Complex and its A-1, A-2 and A-3 stands.

(Above photo) The Space Launch System core stage pathfinder replica is shown installed on the B-2 Test Stand following an Aug. 23-24 lift and handling exercise.



(Top left photo) Children wonder at a demonstration during annual Take Our Children to Work Day activities July 18.

(Top right photo) Stennis Space Center family members enjoy a hands-on exhibit during Family Day activities at INFINITY Science Center on Nov. 2.

(Bottom left photo) A young visitor collects a memento during activities hosted July 20 by Stennis and INFINITY Science Center to commemorate the 50th anniversary of the Apollo 11 mission that carried the first humans to the surface of the Moon.

(Bottom right photo) A NASA "tattoo" station was one of several activities hosted by Stennis during a Pearl River Community College outreach event.

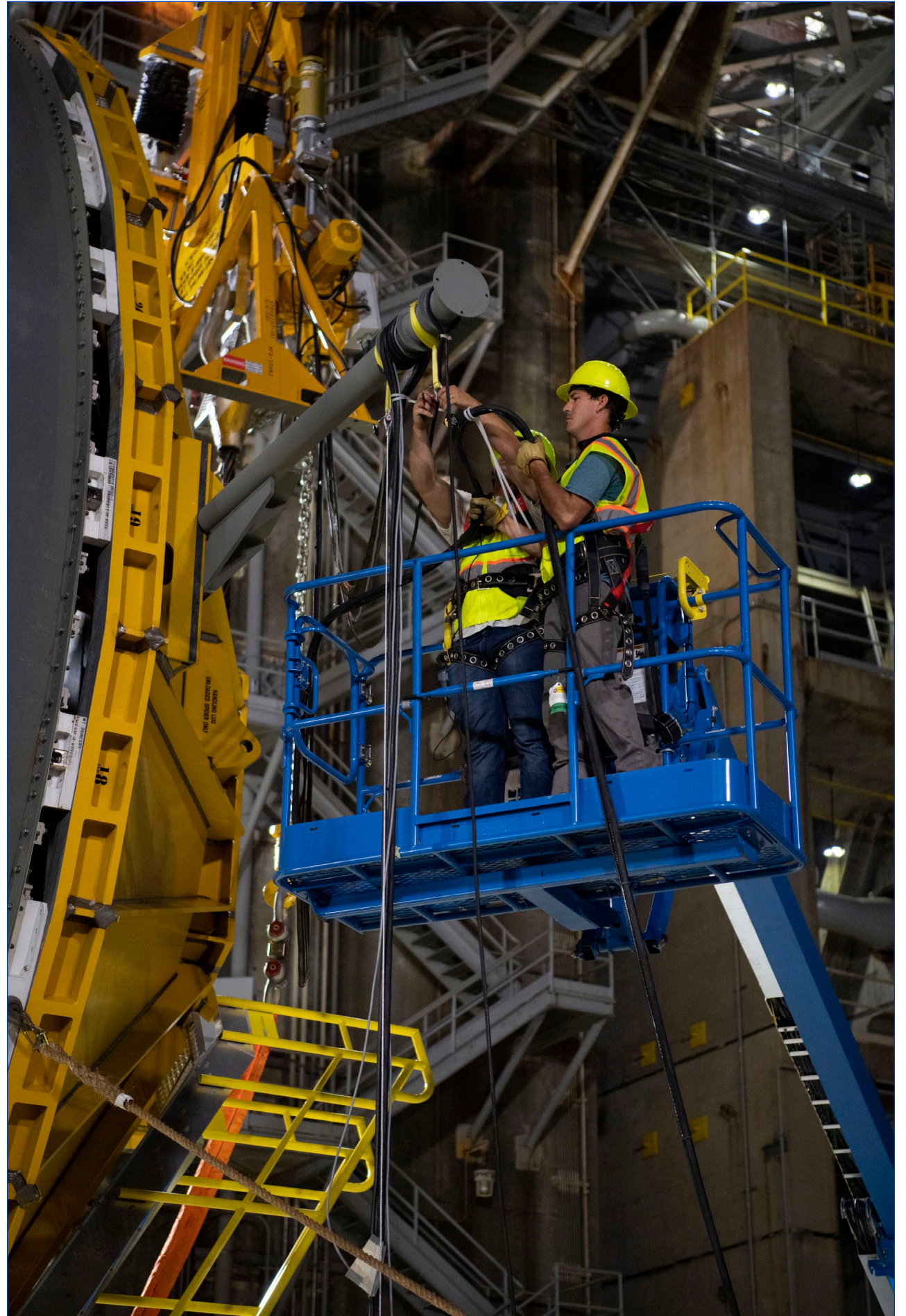


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(Top left photo) A closeup shot shows a Feb. 13 test of RS-25 developmental engine No. 0525 on the A-1 Test Stand at Stennis Space Center. The hot fire was the first of the new year and continued a series of tests on engines that will help power NASA's new Space Launch System rocket.

(Bottom left photo) Operators participate in B Test Complex test control center training session in June on procedures that will be used for core stage testing. The training involved operators from Stennis, as well as Michoud Assembly Facility, Aerojet Rocketdyne and Boeing as they prepare to test the Space Launch Center core stage in 2020.

(Right photo) A work crew participates in an early June training session for handling and lifting the Space Launch System core stage Pathfinder replica at the B-2 Test Stand at Stennis Space Center.



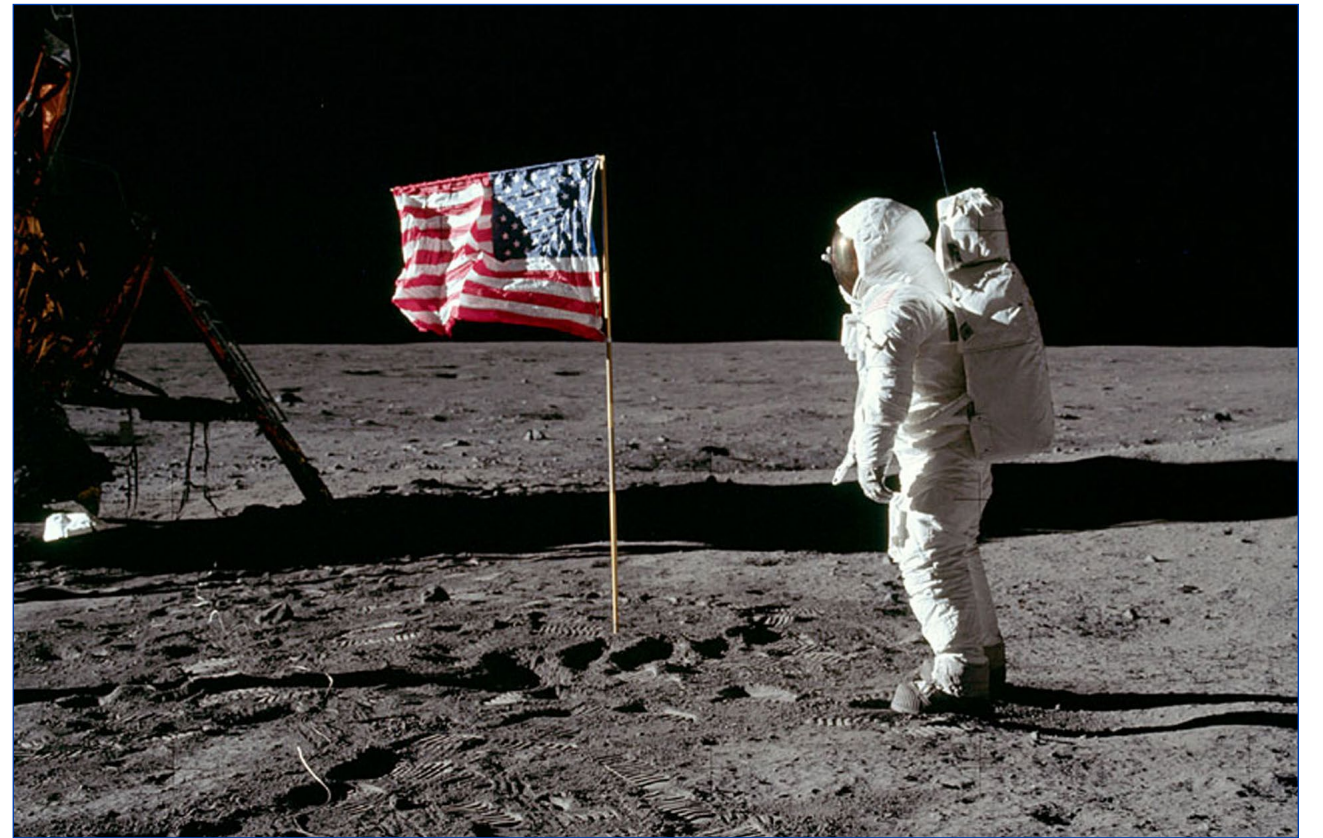


(Left and right photos) Young people enjoy some of the various activities hosted by Stennis Space Center during community outreach events. In the left photo, one signals her support for Stennis as it prepares to test the Space Launch System core stage. In the right photo, another learns about rocket engines from a Stennis engineer.

(Center photo) A participants competes in one of several events during annual South Mississippi Area III Special Olympics Field Games, hosted by Stennis Space Center on March 23. Participants from a four-county area gathering for friendly competition in numerous summer sporting events.



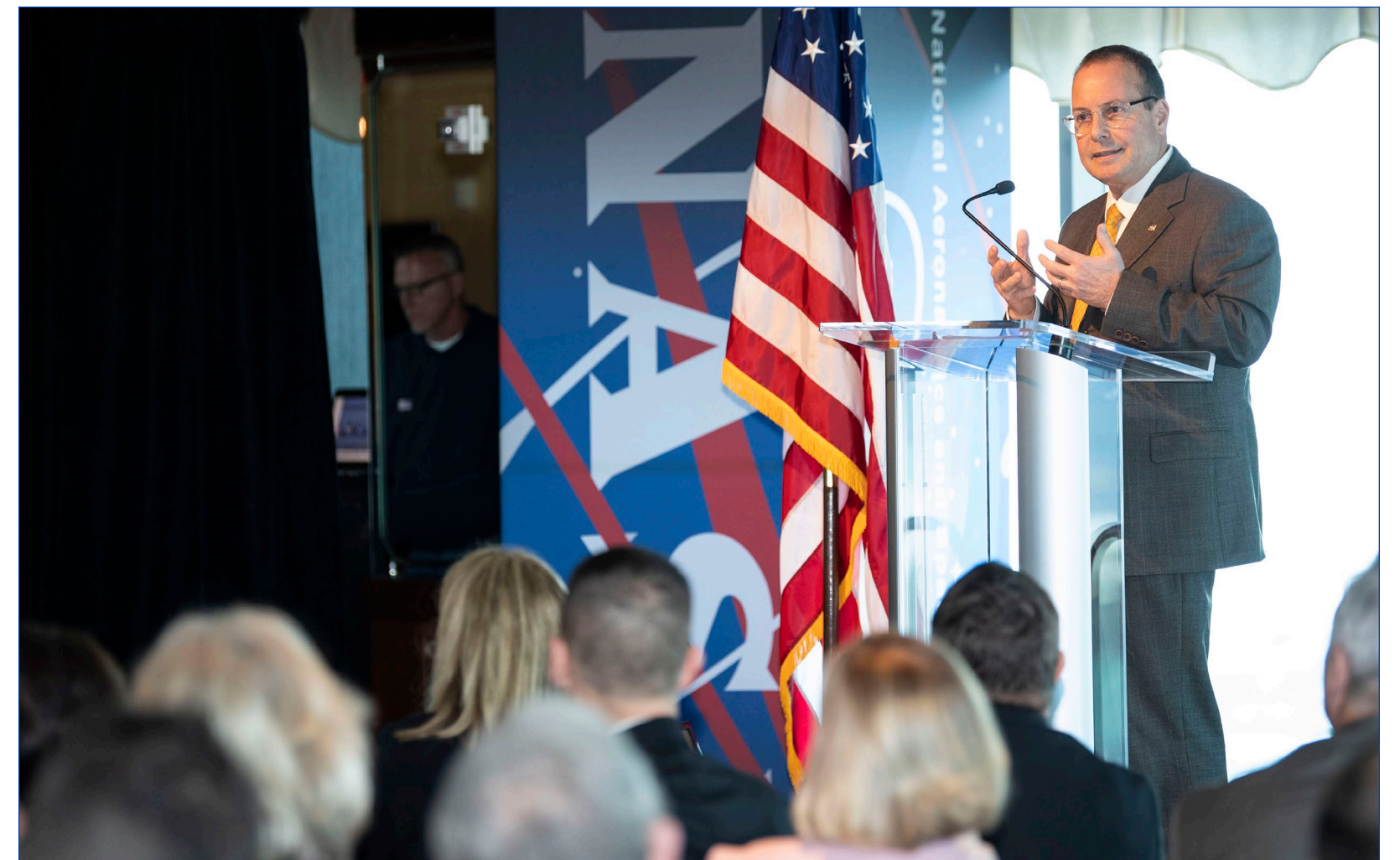
(Top left photo) A visiting media member records comments by Stennis Space Center Deputy Director Randy Galloway during an onsite NASA budget rollout gathering March 11.

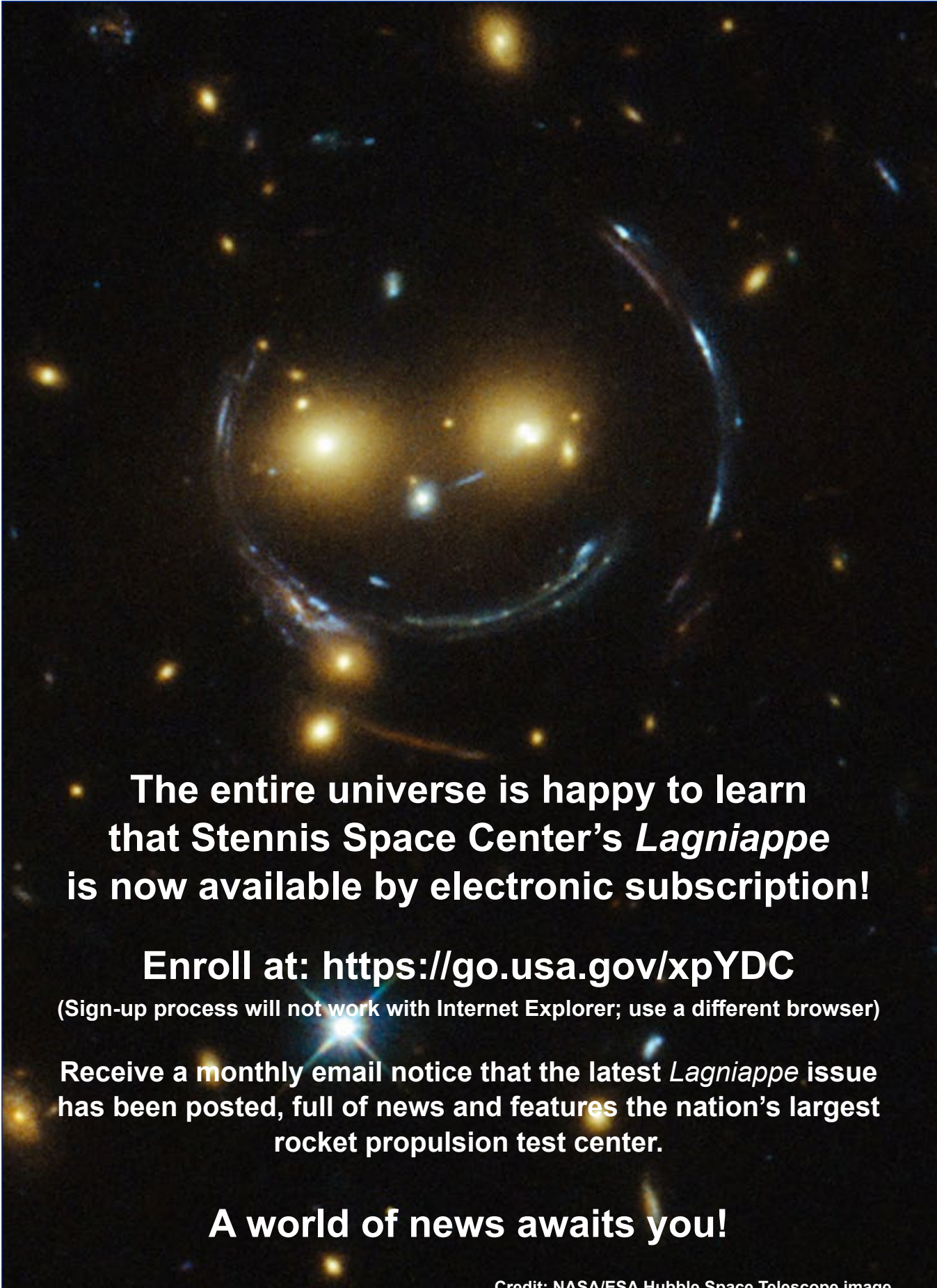


(Top right photo) An iconic photo shows astronaut Buzz Aldrin on the Moon during the Apollo 11 mission in 1969. Last July Stennis Space Center joined NASA centers across the nation to celebrate the 50th anniversary of the historic mission.

(Bottom left photo) Outgoing Mississippi Gov. Phil Bryant announces a new economic development Space Initiative and the formation of the Mississippi National Guard Space Directorate during a July 1 event at INFINITY Science Center.

(Bottom right photo) Stennis Space Center Director Rick Gilbrech delivers an update of ongoing work to Gulf Coast community leaders during an annual briefing hosted by Partners for Stennis and Michoud Assembly Facility.





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Credit: NASA/ESA Hubble Space Telescope image

At Stennis, engineer has one of ‘coolest jobs’ in NASA

When Angelica Baker was young, her mother took her to a local library for preschool storytime. On that day, the library was hosting a NASA astronaut, who spoke to the children about space and even helped them try on a space suit.

“I’ve wanted to be an astronaut ever since,” said Baker, who hails from Canton, Georgia.

Now a resident of Pass Christian, Mississippi, Baker has not made it beyond the Earth’s reaches, but she is pursuing space in her own way. She works as a mechanical operations engineer at NASA’s Stennis Space Center, the nation’s largest rocket propulsion test site.

At Stennis, Baker helps test rocket engines and stages that power space exploration, including those for NASA’s new Space Launch System (SLS). NASA is building SLS to carry humans on deep space missions, to the Moon as part of the Artemis Program and, eventually, to Mars.

Baker is trained to work across all three of the Stennis test complexes – the A complex where RS-25 engines are being tested to help power the SLS core stage, the B complex where the integrated SLS core stage will be tested and the E complex where various NASA and commercial systems and components are tested for space travel. Her current primary project is on the E-3 Test Stand, where she serves as a test conductor for commercial and NASA projects.

Baker began her work at Stennis as a Pathways intern in 2013. NASA Pathways Programs provide opportunities for students and recent graduates to be considered for federal employment through internship, recent graduates and fellowship initiatives.

For her internship, Baker worked in the Stennis Engineering and Test Directorate with the A Test Complex mechanical operations team. The experience led to fulltime – and fulfilling – employment at Stennis following her

graduation from Georgia Institute of Technology in 2015.

“I love the challenge of working in the test complexes,” she said. “There’s always many different, exciting projects going on and lots of variety in the ways I can contribute.”

Baker said she really enjoys working with test teams. “I think we get along well considering how much time we spend together on long test days.”

Baker already has made strides in her work. She was one of two Stennis participants in the NASA FIRST (Foundations of Influence, Relationships, Success and Teamwork) Program for 2018-19. FIRST is NASA’s leadership development program for early career employees.

Overall, Baker characterizes the Stennis workplace as a very “friendly” culture. She also has seen improvement in workplace diversity, although more remains to be done, she added.

During SLS core stage testing next year, Baker will serve as propellant transfer engineer, specifically for liquid hydrogen.

The role places her squarely on the front lines of NASA’s Artemis Program, which will use the SLS rocket to send the first woman and next man to the Moon by 2024.

Stennis has been testing RS-25 engines for the SLS rocket since January 2015. It also has completed extensive modifications of the B-2 Test Stand and its systems in preparation for core stage testing.

“I’m excited to finally test the core stage,” Baker said. “Apollo engineers (who sent the first humans to the Moon in the 1960s and 1970s) were my heroes in school, so now I feel like I am helping to recapture that excitement that they had for space travel today.

“I am really proud of the work we do here at Stennis, testing some of the most complicated machines and doing it well,” she continued. “We have one of the coolest jobs in the agency.”



Working at Stennis Space Center is one of the “coolest jobs” in NASA, Angelica Baker says.

Lockheed Martin to expand operations at Stennis

Global security and aerospace company Lockheed Martin announced Dec. 3 that it is expanding its operations at NASA's Stennis Space Center in Hancock County. The project is a \$20.9-million corporate investment and will create 30 jobs.

"Lockheed Martin is known worldwide as an industry-leading aerospace and defense company, and Mississippi is proud to play an important role in Lockheed Martin's mission to produce spacecraft of the future," Gov. Phil Bryant said. "I thank the company for choosing to grow in Hancock County and for creating dozens of new high-tech jobs for the people of the Mississippi Gulf Coast."

Lockheed Martin is engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. The company's Stennis Space Center location resides within the Space business unit, whose primary activity is to design and build satellites and spacecraft for government and commercial customers.

For the expansion, Lockheed Martin is centralizing select thermal production capabilities to its Stennis location and will begin manufacturing products that are key components of all spacecraft now manufactured by the company.

"The Lockheed Martin team and its space manufactur-

ing capabilities in Stennis deliver superb technical solutions for our customers' missions around the world and beyond," said Jason Wright, Stennis site director for Lockheed Martin. "We value the strong relationship with the state of Mississippi and Hancock County, and we look forward to continuing that partnership by providing high-tech careers that inspire the next generation of the space workforce."

The Mississippi Development Authority (MDA) is providing assistance for building renovations and workforce training. MDA is the state's lead economic and community development agency, focused on new business recruitment, existing business expansion, workforce training and tourism promotion.

"Mississippians take great pride in producing some of the most technologically innovative products on Earth and beyond, which now include advanced products for all spacecraft produced by global leader Lockheed Martin," said MDA Executive Director Glenn McCullough, Jr. "We salute the Lockheed Martin team for once again placing its confidence in the people of Mississippi by bringing these exciting new career opportunities to Hancock County."

Lockheed Martin currently employs 118 workers at its Stennis Space Center location.



NASA team visits Stennis

Members of NASA's Cross Program Integrated Programmatic and Program Control Integration Team visited Stennis Space Center on Dec. 4, touring the Aerojet Rocketdyne Engine Assembly Facility and the B-2 Test Stand, where the core stage of NASA's new Space Launch System will be tested in 2020. The NASA team focuses on executing program integration and services across the agency.



Stennis contributes to research and development



Note: NASA's John C. Stennis Space Center has played a pivotal role in the nation's space program. The following offers a glimpse into the history of the space program and the rocket engine test center.

In his 1961 State of the Union address, then-President John F. Kennedy said, "I believe this nation should commit itself to achieving the goal, before the decade is out, of landing a man on the Moon and returning him safely to Earth."

Researchers at the Langley Research Center and other NASA centers were brainstorming how the United States was going to get a human on the Moon and back home again. Langley already had been working on a solution with Project Mercury years earlier. Using their knowledge and research, NASA successfully sent Alan Shepard to space in May 1961, for a 15-minute suborbital flight in the Mercury capsule, Freedom 7.

Many ideas were considered for putting humans on the Moon, but it came down to three plans: a direct ascent to the Moon and return to Earth without an orbital rendezvous on Earth or the Moon; an Earth Orbital Rendezvous with a launch to the Moon from Earth orbit after the major components of the launch were assembled in orbit around the Earth; or a Lunar Orbital Rendezvous (LOR) which involved going to the Moon, placing one spacecraft in orbit while a second lands on the Moon, returning to the orbiting ship and then returning to Earth.

The third option was the solution Langley research-

ers proposed. After months of research and debate, it was approved. The launch vehicle would be the Saturn V rocket. The first and second stages of the Saturn V rocket would be tested in Hancock County, Mississippi, at what is now called the John C. Stennis Space Center.

In the 1970s, Langley continued working with Stennis (then known as National Space Technology Laboratories – NSTL) in studies of space applications and the development of environmental instrumentation and sensing equipment. Interested in matters having to do with pollution of the environment, Langley sought information and research from NSTL and the facilities that were housed there, including the Earth Resources Laboratory, The Gulf Coast Hydrosience Center, the Atchafalaya Land

and Water Management Study, the National Pesticides Monitoring Laboratory and the Oceanographic Instrumentation Center.

In the 1980s and early 1990s, a short-lived program was instituted by then-President Ronald Reagan called the National Aero-Space Plane (NASP), also known as the Orient Express. The program was never fully realized and

closed about 10 years after it was announced, but the program brought new light and ideas to NASA's research on supersonic and hypersonic vehicles. In the short time NASP was active, Langley and Stennis worked jointly in researching and developing the engines that would take people on a supersonic flight. The plan was neither monetarily feasible nor physically practical for passengers, so the project was canceled, but the ingenuity was there.

Stennis, working with Langley in the last 50 years, has seen tremendous gains in research and development.



An older design model of the National Aero-Space Plane pursued in the 1980s and 1990s remains on display at the U.S. Space and Rocket Center in Huntsville, Ala.

Hail & Farewell

NASA welcomes the following:

Jared Meredith

Tristan Mooney

Claire O'Shaughnessy

Timothy Stiglets

AST, Safety and Mission Assurance

AST, Electrical Experimental Equipment

AST, Experimental Facilities Techniques

Management and Program Analyst

Safety and Mission Assurance Directorate

Engineering and Test Directorate

Center Operations Directorate

Engineering and Test Directorate

Office of Diversity and Equal Opportunity

Religious inclusion in the federal workplace

The prohibition on religious discrimination in the workplace is firmly grounded to the United States Constitution. The nation's founders adopted the First Amendment to the Constitution, which prohibits Congress from making any law respecting an establishment of religion. It also prevents Congress from making laws that prohibit the free exercise of religion. Both prohibitions have been passed on to employers as workplace antidiscrimination laws, regulations and policies.

Title VII of the Civil Rights Act of 1964 prohibits employers from discriminating against individuals because of their religion (or lack of religious belief) in hiring, firing, pay, job assignments, promotions, training, fringe benefits and any other term or condition of employment. Additionally, an employee cannot be forced to participate (or not participate) in a religious activity as a condition of employment.

Religious discrimination involves treating a person unfavorably because of his or her religious beliefs. The law protects not only people who belong to traditional, organized religions – such as Buddhism, Christianity, Hinduism, Islam and Judaism – but also others who have sincerely held religious, ethical or moral beliefs.

Religious discrimination can also involve treating someone differently because that person is married to (or associated with) an individual of a particular religion.

It is illegal to harass a person because of his or her religion. Harassment can include, for example, offensive remarks about a person's religious beliefs or practices. Although the law does not prohibit simple teasing, offhand comments or isolated incidents that are not very serious, harassment is illegal when it is so frequent or severe that it creates a hostile or offensive work environment or when it results in an adverse employment decision, such as the victim being fired or demoted.

The harasser can be the victim's supervisor, a supervisor in another area, a co-worker or someone who is not an employee of the employer, such as a client or customer.

Title VII also prohibits workplace or job segregation based on religion (including religious garb and grooming practices), such as assigning an employee

to a non-customer contact position because of actual or feared customer preference.

The law requires an employer or other covered entity to reasonably accommodate an employee's religious beliefs or practices, unless doing so would cause more than a minimal burden on the operations of the employer's business. An accommodation may cause undue hardship if it is costly, compromises workplace safety, decreases workplace efficiency, infringes on the rights of other employees or requires other employees to do more than their share of potentially hazardous or burdensome work.

Examples of some common religious accommodations include flexible scheduling, voluntary shift substitutions or swaps, job reassignments and modifications to workplace policies or practices.

Accommodations may also include allowing dress or grooming practices that an employee has for religious reasons, including wearing particular head coverings or other religious dress (such as a Jewish yarmulke or a Muslim headscarf), or wearing certain hairstyles or facial hair (such as Rastafarian dreadlocks or Sikh uncut hair and beard). It also includes an employee's observance of a religious prohibition against wearing certain garments (such as pants or miniskirts).

The holiday season is a great opportunity for employees to bond over social events and sugar cookies, but they can also be a source of conflict and lead to hurt feelings, discomfort or worse – a charge of religious discrimination.

It is virtually impossible to ask workers to keep their religious holiday observances completely separate from work. The key is to make sure no one feels excluded or forced to participate in workplace festivities. Diversity, whether it involves religion or the gender of the partner someone brings to a workplace party, should be celebrated along with the holidays so that everyone feels welcome.

For additional information regarding religious discrimination in the workplace, visit online at: <https://www.eeoc.gov/laws/types/religion.cfm>.

Information included in this article was obtained from: <https://www.eeoc.gov/laws/types/religion.cfm>.

Stennis employee inspired to be part of NASA greatness

Juan E. Rodriguez is easily moved by events and situations. He feels chills every time singers hit the high notes of the national anthem. So, it is natural that his earliest space-related memory, the space shuttle Challenger tragedy in 1986, would make an impression on a young Rodriguez.

"I recognized the impact that space and space travel had on the entire nation," said Rodriguez, who hails from New Jersey, most notably the Hoboken and Newark areas.

For the past three-and-a-half years, Rodriguez has been making an impact on space and space travel in his own way, as an accountant in accounts receivable at the NASA Shared Services Center located at Stennis Space Center. His duties in that role involve monitoring, reviewing, reconciling and analyzing NASA's accounting transactions and data to ensure that all are in compliance with federal regulations and that the NASA Shared Services Center is delivering quality service to its sister agency centers and customers.

"We support every NASA center and their various financial activities that contribute to all aspects of NASA's missions," Rodriguez said. This includes the agency's Artemis Program, which will send humans, including the first woman and next man, to the Moon by 2024. From that point, NASA is committed to traveling to other deep space destinations, including Mars. Stennis is testing rocket engines and stages to help power the new Space Launch System rocket that is the backbone vehicle of the Artemis Program and missions elsewhere.

In addition to his work in the financial realm, the transplanted Diamondhead, Mississippi, resident also is using his easily inspired nature in his role as the Special Emphasis Program manager for individuals with a disability at the NASA Shared Services Center and Stennis.

"My goal is to create and share a learning environment about individuals with a disability," Rodriguez said.

Special Emphasis Programs were established more than 40 years ago to focus attention on groups that have historically been absent or underrepresented in specific occupational categories or grade levels in the federal workplace. Several managers work at the NASA Shared Services Center and Stennis to highlight various affected groups.

Overall, Rodriguez believes the two entities are well diversified, thanks in part to the southern tradition of hospitality and the blending of diverse rich cultures of hospitality and coastal life. "How can any-

one say 'no' to the Crawfish Festival and Mardi Gras?" he said. "These elements are an essential part of what makes Stennis Space Center unique."

Rodriguez began his career in the federal sector in 2007, following graduation from the Rochester (New York) Institute of Technology. He worked with the U.S. Army prior to transferring to NASA and Stennis in 2016.

It has been a positive move, he said. "The best thing about working at Stennis is the people. Everyone is super friendly and a team player. We are small in numbers but great in spirit."



Juan Rodriguez is inspired being part of something great as a NASA Shared Services Center employee at Stennis.

He looks forward to the possibility of working alongside engineers and propulsion testers one day. "That would be exciting," he said.

Rodriguez was selected for the 2018 NASA FIRST (Foundations of Influence, Relationships, Success and Teamwork) Program, NASA's leadership development program for early career employees. He also has received "on the Spot" awards for systems training he led earlier this year.

"I learned from the FIRST Program to apply the concept of accountability, to adapt to changes, to be vulnerable and to ground my inner core," Rodriguez said. "These essential elements enable me to apply the discipline needed to achieve my goals. Along with these crucial elements is the inspiration of NASA's mission objectives and the feeling of being part of a great moment as we gear up to travel back to the Moon and beyond."

Happy Holidays



from the Stennis Space Center family