



KENNEDY SPACE CENTER'S  
SPACEPORT  
magazine

**In the  
Driver's Seat  
for Artemis I**



# KENNEDY SPACE CENTER'S SPACEPORT MAGAZINE

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Breanne Stichler, mechanical engineer I, is photographed with NASA's Crawler-Transporter 2 (CT-2) at the Kennedy Space Center in Florida on Aug. 8, 2019. Stichler started working at Kennedy in June and is among one of the few females to have ever driven the crawler. CT-2 will carry the agency's mobile launcher with the Space Launch System rocket from the Vehicle Assembly Building to Launch Pad 39B for the launch of Artemis I, the first in a series of complex missions that will provide the foundation for human deep space exploration. Photo credit: NASA/Ben Smegelsky

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Kennedy Space Center has its own monthly podcast. Welcome to the "Rocket Ranch." [Listen to Episode 13: When Rockets Need Rescue.](#) In this episode, we unpack the need and value of test flights with Jon Cowart, as well as dig into the recent, successful, second test of Orion's Launch Abort System with Carolos Garcia. Check out Episode 13, read the full transcript and catch up on missed episodes at <https://www.nasa.gov/kennedy/rocketranch>.

National Aeronautics and Space Administration



# KENNEDY

## SPACE CENTER

### JENNIFER MORGAN

My name is Jennifer Morgan. I am manager of Partnership Development in the Center Planning and Development (CPD) Directorate at NASA's Kennedy Space Center in Florida.

My responsibilities include the planning, management and execution of partnership activities. Partnerships are instrumental in supporting the agency's strategic plan and objectives, including advancing U.S. competitiveness, disseminating the results of NASA's activities to educate and inspire, and facilitating the efficient use and management of NASA infrastructure and capabilities.

I began my career at Kennedy as a co-op student in 1999 in the Mechanical Systems Division. I had the opportunity to work on the Space Shuttle Program as a mechanical systems engineer. I have been in my current position since 2015.

I have thoroughly enjoyed my various positions at Kennedy. After many years in engineering, I saw an opportunity to contribute to the growth of the multi-user spaceport. Enabling partners to use NASA capabilities for the greater good of space exploration is very rewarding. It is similar to sharing your favorite toy with a friend.

Because of the volume of proposed partnerships in CPD, it can be challenging to manage the expectations of partners and support their requested deadlines. Teamwork is our key to overcoming these challenges. CPD receives great support from other directorates and programs, including Spaceport Integration, Engineering, Exploration Ground Systems, Information Technology, Safety and Mission Assurance, the Chief Financial Officer and Chief Counsel, to get these agreements executed properly.

My favorite memories involve the people I work with and the friendships I have made. We are a NASA family. Through different stages of my career, they have been by my side. My five children are named after some of my favorite co-workers.

# In the *Driver's* Seat

Breanne Stichler, mechanical engineer I, is photographed inside the cab of NASA's crawler-transporter 2 (CT-2) at Kennedy Space Center on Aug. 8, 2019. Stichler started working at Kennedy in June and is among one of the few females to have ever driven the crawler. Photo credit: NASA/Ben Smegelsky



## Engineer earning crawler-transporter certification for Artemis I

BY DANIELLE SEMPSROTT

Weighing in around 6 million pounds, NASA's **crawler-transporter 2** will carry the agency's **mobile launcher** with the **Space Launch System (SLS)** rocket and Orion spacecraft – an additional 18 million pounds – from the **Vehicle Assembly Building (VAB)** to **Launch Pad 39B** for the launch of **Artemis I**. And driving all of that weight around is no easy task – something that Breanne Stichler, one of the few women to ever drive the crawler, is discovering.

Stichler, 22, is a mechanical engineer and now one of nine crawler drivers at NASA's Kennedy Space Center in Florida, and is still learning how to drive the enormous vehicle.

"Getting to drive the crawler is a rare opportunity, because there are only two in existence," said Stichler. "It's also very intimidating because of its massive size."

The entire journey down the crawlerway from the VAB to the pad – just over four miles – takes a minimum of eight hours. Learning how to drive the crawler-transporter requires specialized training with a second engineer in the cab as well as communication between the driver and other engineers and technicians regarding direction, any necessary adjustments, level readings and more.

"The straight sections of the crawlerway are surprisingly difficult. Because of the size of the crawler, you don't feel like you're moving off course as much as you really are," said Stichler.

After mastering the art of driving straight, she'll begin learning how to drive the curves. Given that the crawler-transporter is large enough to fit a baseball diamond on top, turning requires a little more practice. Since the vehicle is only designed to make six-degree turns, drivers need to start turning well in advance when approaching curves on the crawlerway.

"Driving the crawler is a bit like steering a large ship," said Stichler. "And when the rocket is onboard, it will be like steering a large ship with a skyscraper on top."

In order to drive alone, engineers have to complete a certification process that can take a few years, depending on how often the crawler

moves and how many opportunities there are to drive and perform the specific maneuvers the certificate requires. Even once drivers are certified to drive alone, a backup is usually present in the cab whenever possible.

"Being a certified crawler driver is not just learning how to drive the crawler. You must also understand and be able to operate the crawler's other major subsystems," said John Giles, crawler project manager. "After one to two more years of on-the-job training, Breanne will be on her way to becoming a certified crawler driver."

Stichler is part of a younger workforce at Kennedy – the Artemis generation – preparing to expand human exploration to the **Moon and on to Mars**.

A recent graduate from the University of Central Florida, she received her degree in aerospace engineering. The summer before her senior year, Stichler interned for Jacobs Engineering Group Inc. on the Test and Operations Support Contract in the asset management department. Through this internship, she had the opportunity to work on multiple projects, and it was there that she was first introduced to the crawler.

"It's awesome being a part of the Artemis program," she said. "Being out here has always been a dream of mine, and it's exciting to have that dream turn into reality at such a historic time for NASA."

The next big move for the crawler will take place this fall to bring the mobile launcher back to the VAB from the pad – where it has been since June undergoing final testing – to begin preparations for SLS and Orion stacking for its first-ever deep space launch.



Breanne Stichler, mechanical engineer I, is photographed inside the cab of NASA's crawler-transporter 2 (CT-2) at the Kennedy Space Center in Florida on Aug. 8, 2019.

# Focus On WOMEN

## Kennedy leaders share experiences during Women's Equality Day panel discussion

BY LINDA HERRIDGE

The 19th amendment to the U.S. Constitution, guaranteeing all American women the right to vote, became law on Aug. 18, 1920. To honor the 100th anniversary of this right, Kennedy Space Center employees gathered to hear from some of the center's senior woman leaders during a panel discussion on Aug. 26, 2019, to celebrate Women's Equality Day. The event was organized by Kennedy Networking Opportunities for Women (KNOW), one of the center's employee resource groups.

The purpose of KNOW is to provide focus on issues such as employment, retention, promotion, training, career and personal development, education, and identify and eliminate barriers that hinder the advancement of women in the workforce.

"Women's Equality Day was first celebrated in 1973, and it commemorates the signing of the 19th amendment which gave women the right to vote in the United States," said Rebecca Baturin, Mobile Launcher 2 project management support in Exploration Ground Systems and KNOW chairperson. "We've come a long way since the 1920s, and I'm proud to work at Kennedy where more than 50 percent of our senior executive service team is female."

Ashley Nelsen, information manager for the Launch Services Program (LSP),

moderated the panel discussion, which featured Digna Carballosa, director of the Human Resources (HR) Office; Nancy Bray, director of Spaceport Integration and Services; Jennifer Kunz, director of Safety and Mission Assurance (S&MA); and Amanda Mitskevich, LSP manager.

**"DIVERSITY ISN'T ABOUT JUST BEING INVITED TO THE PARTY, IT'S ABOUT BEING ASKED TO DANCE."**

Jennifer Kunz  
Director, Safety and Mission Assurance

In high school, Bray loved math. Then she got to the University of Florida with the goal of becoming an accountant. She took the first course and her head was spinning. "I left accounting and went to industrial engineering, and that's what brought me to my career here at NASA," Bray said. "In 1988, when I graduated, NASA was looking for women engineers. I've been here 30 years now and loved every minute."

Kunz was interested in chemistry in high school. She switched her interest to industrial engineering in college. She took four classes in that field and liked it so much that she earned a degree in it. "After graduating, evidently my dad was looking

for a job for me harder than I was looking. He sent my resume to all of his friends. One of them made it to NASA. Next thing I know I get a call from human resources at Kennedy. They interviewed me twice and the rest is history," Kunz said. "I've been here almost 29 years and I've loved everything that I've been allowed to do."

Mitskevich also is an industrial engineer. She went to Georgia Tech and decided to try electrical engineering. Two years later she changed direction and decided to major in industrial engineering. "It turned out to be a great combination of engineering and business classes," Mitskevich said. After graduating in 1987, she saw some job postings on a board that led to her being interviewed for a position at Kennedy Space Center.

The senior leaders have seen positive change regarding women at Kennedy.

Bray said there has been a huge change. When she first arrived at Kennedy, only one woman, JoAnn Morgan, was in a leadership role. "Before I became a director, almost all of the deputies were women," Bray said. She never experienced discrimination in the workplace, but has had one opportunity after another since she came to NASA.

Kunz commented that promoting women into leadership is less a matter of title, and more about leadership qualities. "It's the way that we lead teams and how



we interact with people," Kunz said. "I have never felt discriminated against. It's a lot about balancing what you want and what you bring to the table."

Sometimes, Mitskevich said, others see your potential first. "People see something in you and have expectations that you can do the next thing." She said Center Director Bob Cabana has made a movement to get more diversity on senior staff. "He's worked to get more diversity of thought around the table."

Carballosa has been at Kennedy for four years. Unlike her colleagues, she did experience some discrimination along the way. "I started my career at the Office of Personnel Management (OPM) in

Washington, D.C. in 1992," Carballosa said. "Growing up in Miami, where there's a lot of ethnic diversity, and then going to Washington, where there wasn't, was quite a shock for me. I had to work really hard to be understood by the people I was talking to. It was a challenge. I think your work speaks for you, and after people got to know me, they gave me every opportunity."

Kunz described a time during space shuttle days when she was shadowing JoAnn Morgan at a review meeting. "As we were walking towards the room, her comment was, 'you will see more astronauts in that room than women,'" Kunz said. "And she was right. I look around meetings that we

A panel discussion, featuring women in leadership roles at NASA's Kennedy Space Center was held on Aug. 26, 2019, to celebrate Women's Equality Day. The event, sponsored by the Kennedy Networking Opportunities for Women (KNOW) employee resource group, honored the 100th anniversary of the passing of the 19th amendment guaranteeing all American women the right to vote. Seated, from left, are Digna Carballosa, director of the Human Resources Office; Nancy Bray, director of Spaceport Integration and Services; Jennifer Kunz, director of Safety and Mission Assurance; and Amanda Mitskevich, Launch Services Program manager. Photo credit: NASA/ Cory Huston

have now, and with all the new people we've hired in, there's much more diversity in the workforce, with younger and mid-career women coming in."

Kunz said moving around is a great opportunity to learn new things. "A mentor once said: 'Don't ever look back when you have opportunities. Seize them, because when you have been a good person who worked hard, they will always want you back,'" Kunz said.

Bray echoes that advice. "If an opportunity comes along that you didn't expect, take it; you never know where it's going to lead. You never know the connections you'll make. You never know where it will lead, and the experience you will gain.

Space can be a difficult business, and making those connections with team members and other leaders can help when times get tough.

"When you get into an adversity situation, all the people that you work with are the people who you can count on to help. The relationships that you build with all of the folks that work for you and with you really help in situations like that," Mitskevich added.

How do these leaders foster diversity and inclusion in their teams?

Mitskevich said LSP takes a proactive approach. Once a year they go offsite for

a strategic meeting to plan ahead, and the program started inviting some early career workers into the mix to get fresh ideas and opinions. “It’s made a huge difference in how we make decisions and implement work,” she said. LSP also put together a team of workers across the entire program and all of its supporting disciplines, bringing new ideas together in a collaborative way.

“A manager who never listens will eventually be surrounded by people that have nothing to say,” Kunz said. “I think that it’s not really that people lose their voice, it’s that the person that is supposed to be listening never had the ability to listen. People just quiet their voice. That is a really dangerous thing.” Kunz said that in S&MA there is always a manager who will listen. Kunz shared some advice from one of her mentors: “Diversity isn’t about just being

invited to the party, it’s about being asked to dance. There’s a difference. You filled the room with people. You have to ask for the feedback. You have to give them the chance to participate. It’s important to create those networks,” Kunz said.

Carballosa is intentional in selections when filling positions. “I want to help create a workforce that is ready to take on the next role, whether it’s at the agency or whether it’s here locally. We have a great group of employees at Kennedy and I’m very intentional about giving them opportunities to get in front of a room of senior leaders and tackle issues that have never been tackled before. I think that’s how we prepare our future leaders.”

Finding people who are completely different from you also is important. “If we’re all thinking the same, who is bringing the new ideas?” Bray said. “It’s important

**“IF AN OPPORTUNITY COMES ALONG THAT YOU DIDN’T EXPECT, TAKE IT; YOU NEVER KNOW WHERE IT’S GOING TO LEAD.”**

**Nancy Bray  
Director, Spaceport Integration  
and Services**

to break away from the warm, safe zone. It’s important to build teams that way. You have to be very intentional and mix it up. In the end, you come out with a better product.”

Today, all four panelists are focused on their organizations’ roles in supporting NASA’s Artemis missions to the Moon and on to Mars.

“For me, and for Spaceport Integration and Services, our tagline is ‘We assure



NASA’s access to space,” Bray said. “We’re challenging our team to think differently about that if we want to get boots on the Moon by 2024,” Bray said.

Kunz said: “We have to assure mission success, and the safety of our employees at the center. Our challenge is to learn from what we’ve done in Commercial Resupply Services, Commercial Crew Program and Launch Services Program. We have employees from our organization that are working on the Gateway board to be able to do the logistics element. There are a lot of safety requirements. We need to know what matters, so that we can protect the things we need to protect.”

Mitskevich said LSP is trying to figure out how they can be more flexible than they’ve been in the past regarding their insight and approval role for launch vehicles. “Some of the launch vehicles are brand new. They’ll fly for the first time maybe in 2021. We have to be boots on the Moon in 2024,” Mitskevich said.

From an HR perspective, Carballosa said, “We need to recruit people with the right skills. We also need to create an environment where employees can grow and have opportunities, and are able to balance work and life so that all of us can be successful.”

Four senior leaders participated in a panel discussion at Kennedy on Aug. 26, 2019, to celebrate Women’s Equality Day. Seated in front from left, are Digna Carballosa, director of the Human Resources Office; Nancy Bray, director of Spaceport Integration and Services; Jennifer Kunz, director of Safety and Mission Assurance; and Amanda Mitskevich, Launch Services Program manager. At far left is Ashley Neisen, Launch Service Program information manager and panel discussion moderator. Photo credit: NASA/Cory Huston



Kennedy Space Center employees attended a panel discussion featuring women in leadership roles, on Aug. 26, 2019, for Women’s Equality Day. Seated in front, from left, are Digna Carballosa, director of the Human Resources Office; Nancy Bray, director of Spaceport Integration and Services; Jennifer Kunz, director of Safety and Mission Assurance; and Amanda Mitskevich, Launch Services Program manager. At far left is Ashley Neisen, Launch Service Program information manager and panel discussion moderator. Photo credit: NASA/Cory Huston





A model of Northrop Grumman's Omega launch vehicle is flanked by the U.S. flag and a flag bearing the Omega logo during a ribbon-cutting ceremony Aug. 16 in High Bay 2 of the Vehicle Assembly Building. Photo credit: NASA/Kim Shiflett

Below: From left to right, Kennedy Space Center Director Bob Cabana, Northrop Grumman Vice President and Omega Capture Lead Kent Rominger, and Col. Thomas Ste. Marie, vice commander of the U.S. Air Force's 45th Space Wing, cut the ribbon in High Bay 2. Photo credit: NASA/Kim Shiflett



After spending more than 50 years supporting NASA's human spaceflight programs, the **Vehicle Assembly Building (VAB)**, a landmark at the agency's Kennedy Space Center in Florida, is getting its first commercial tenant.

Northrop Grumman will assemble and test its new Omega rocket inside the massive facility's High Bay 2, one of four high bays in the building. Officials with NASA, Northrop Grumman and the U.S. Air Force gathered in High Bay 2 on Aug. 16 to celebrate the partnership with a ribbon-cutting ceremony attended by legislative representatives and spaceport employees.

"We have a great partnership with Northrop Grumman; we have a great partnership with all our partners," said Kennedy Space Center Director Bob Cabana. "It's a great pleasure to be able to be here today and cut the ribbon after signing this historic agreement to utilize this awesome facility to support our nation's space program."

Northrop Grumman signed a Reimbursable Space Act Agreement

with NASA for use of the facilities. The company is developing the Omega rocket, an intermediate/heavy-class launch vehicle, as a part of a launch services agreement with the U.S. Air Force.

Kennedy has transformed from a government-only space launch complex to the nation's premier multi-user spaceport. Today, the space center has more than 90 active agreements with private-sector partners, sharing its array of unique facilities and resources through partnerships with government and commercial organizations.

This latest agreement brings Northrop Grumman into the fold.

"With Omega, we truly are standing on the shoulders of the giants of space history," said Kent Rominger, Northrop Grumman's vice president and capture lead for the Omega launch system, as well as a veteran of five space shuttle flights. "This event marks that partnership with [Kennedy] at this phenomenal spaceport."

The addition of Northrop Grumman's Omega rocket to the stable of vehicles processed and launched from the spaceport continues a long legacy that defines the local community

"This whole area has been home to innovation and the drive to be bolder," said Col. Thomas Ste. Marie, vice commander of the U.S. Air Force's 45th Space Wing. "These efforts, government and contractor, have fueled the economies and the imagination and, really, the spirit of this community that we like to call the Space Coast."

# MOVING IN

**Northrop Grumman becomes first commercial partner to use Vehicle Assembly Building**

BY ANNA HEINEY

# NASA's ICON Mission to Launch on Pegasus Rocket

**MISSION:** NASA's Ionospheric Connection Explorer (ICON)

**LAUNCH DATE:** Oct. 9, 2019

**LAUNCH VEHICLE:** Northrop Grumman [Pegasus XL](#) rocket  
The only operational airborne launch rocket

**LAUNCHED FROM:** Northrop Grumman [L-1011 Stargazer](#) aircraft

**LAUNCH SITE:** Cape Canaveral Air Force Station in Florida

**PAYLOAD:** The Ionospheric Connection Explorer (ICON)

**MISSION:** The [ICON](#) mission will study the frontier of space, the dynamic zone high in Earth's atmosphere where terrestrial weather from below meets space weather above. In this region, the tenuous gases are anything but quiet, as a mix of neutral and charged particles travel through in giant winds. These winds can change on a wide variety of time scales due to Earth's seasons, the day's heating and cooling, and incoming bursts of radiation from the Sun.

## ICON INSTRUMENTS:

- ✦ **MIGHTI:** The Michelson Interferometer for Global High-resolution Thermospheric Imaging instrument observes the temperature and speed of the neutral atmosphere. These winds and temperature fluctuations are driven by weather patterns closer to Earth's surface. In turn, the neutral winds drive the motions of the charged particles in space. MIGHTI was built by the Naval Research Laboratory in Washington, DC.
- ✦ **IVM:** The Ion Velocity Meter will observe the speed of the charged particles, in response to the push of the high altitude winds as well as the electric fields they generate. The IVM was built by the University of Texas at Dallas.
- ✦ **EUV:** The Extreme Ultra-Violet instrument captures images of oxygen glowing in the upper atmosphere, in order to measure the height and density of the daytime ionosphere. This helps track the response of the space environment to weather in the lower atmosphere. EUV was built by the University of California at Berkeley.
- ✦ **FUV:** The Far Ultra-Violet instrument captures images of the upper atmosphere in the far ultraviolet light range. At night, FUV measures the density of the ionosphere, tracking how it responds to weather in the lower atmosphere. During the day, FUV measures changes in the chemistry of the upper atmosphere – the source for the charged gases found higher up in space. FUV was built by the University of California at Berkeley.



Technicians extend the solar array on NASA's Ionospheric Connection Explorer (ICON) during a deployment test inside Building 1555 at Vandenberg Air Force Base in California on Aug. 10, 2019. ICON will launch on a Pegasus XL rocket, attached beneath Northrop Grumman's L-1011 Stargazer aircraft, from the Skid Strip at Cape Canaveral Air Force Station in Florida. Launch is scheduled for Oct. 9. ICON will study the frontier of space - the dynamic zone high in Earth's atmosphere where terrestrial weather from below meets space weather above. The explorer will help determine the physics of Earth's space environment and pave the way for mitigating its effects on our technology and communications systems. Photo credit: NASA/Randy Beaudoin

# MILESTONE COMPLETE

## Pad 39B water flow test comes through loud and clear

BY JIM CAWLEY

NASA eclipsed another milestone in its plan to send the first woman and next man to the lunar surface by 2024 with the latest successful water flow test on the **mobile launcher** at Kennedy Space Center's **Pad 39B**.

Using adjustments from the first water flow test event in July, the Friday, Sept. 13 exercise demonstrated the capability of the sound suppression system that will be used for launch of **NASA's Space Launch System (SLS)** for the **Artemis I** mission.

During the 30-second test, about 450,000 gallons of water poured onto the Pad B flame deflector, the mobile launcher flame hole and onto the launcher's blast deck. The system reached a peak flow rate of more than 1 million gallons per minute. While the visual is dramatic, the water's main purpose come launch day involves sound.

NASA continued its preparation for the Artemis I mission with a successful water flow test on the mobile launcher at Kennedy Space Center's Launch Pad 39B on Sept. 13, 2019. Photo credit: NASA/Kim Shiflett

"SLS will create about 176 decibels at liftoff, which is significantly louder than a jetliner," said Launchpad Element Deputy Project Manager Nick Moss. "The sheets of water created by the flow will curb that sound by knocking it down a few decibels."

When the rocket's engines ramp up to full power, the hot exhaust starts to push harder in the confined space of the mobile launcher. These pressure waves can cause vibrations that could potentially damage the mobile launcher, as well as the rocket about to take flight.

"The sound suppression system acts as a dampener, absorbing the acoustic energy and reducing the strength of the pressure waves," said Cliff Lanham, mobile launcher senior project manager. "It creates a protective environment to ensure safe liftoff."

The sound suppression system starts flowing about 20 seconds before T-Zero. Smoke and fire from the vehicle starts about 10 seconds later.

"And that's what we're all here for — making sure that we can get to those last 10 seconds safely and get the vehicle going," Moss said.

Friday's test was the first time the ground launch sequencer software that will be used on launch day was used to command launch support systems at Pad B from the Launch Control Center. The weekend tests included a nominal launch countdown flow and a single valve failure test flow to better characterize off-nominal system performance.

The team is currently performing post-test analysis on these events in preparation for a final water flow test in the coming weeks, involving the hydrogen burn-off igniters.





Three Gateway Logistics Element workers at NASA's Kennedy Space Center traveled around the world and carried the NASA flag with them as they reached new heights.



Above: Mark Wiese, left, Gateway Logistics Element manager, and his son Mason, carried the NASA flag with them to Haleakala Volcano, about 10,023 feet above sea level, on July 10, 2019. Luckily they could drive to the top, which took about 2.5 hours. "This was my third trip up Haleakala to watch the sunset and see the stars emerge; the experience never disappoints," said Wiese. "Every trip reminds me how amazing this planet is, and what awesome opportunities we have at NASA to explore space and gain new perspectives." Photo courtesy of Mark Wiese.

Right: Ron Mueller, left, Gateway Logistics Element architect, holds the NASA flag with his wife Daisy, Launch Services Program Business Office, at Machu Picchu, Peru, on July 22, 2019. Mueller and his wife first made the trek 8,835 feet above sea level to Temple of the Moon at Huayna Picchu, just over 1,000 feet above Machu Picchu. "It was a clear day, with both the Sun and Moon visible at a sacred place for the ancient Inca," Mueller said. "Machu Picchu was a key location for Incan astronomical observations." Photo courtesy of Ron Mueller.



Above: Paul Hintze, second from left, chief of the Exploration Systems and Development Office in the Exploration Research and Technology Programs, made the trek up to Mt. Everest Base Camp, along with his wife, Debra Woodall, far left. They arrived at the camp on May 28, 2019. The round trip up and back took 15 days. Their trek started at an elevation of 9,350 feet. The highest elevation was 17,675, when they went over the Cho La Pass. Also with them were Bhalakaji Magar, the porter, second from right, and Dambar Bahadur Magar, the guide. "Traveling to Everest Base Camp is walking in the footsteps of some of the world's greatest adventurers," Hintze said. "In many ways, it has not changed much since the first attempts to summit the mountain. The views, the wildlife, and the people all made it a unique and inspiring experience." Photo courtesy of Paul Hintze.

# COMPLETE MAKEOVER

## VAB Utility Annex getting upgrades to support Artemis missions

BY LINDA HERRIDGE

It may be one of the smaller facilities at NASA's Kennedy Space Center in Florida, but the Utility Annex adjacent to the **Vehicle Assembly Building (VAB)** provides large amounts of commodities, including about 8,000 gallons of chilled water per minute, to the VAB and other surrounding facilities. These commodities are necessary as the center prepares for the agency's **Artemis** missions to the Moon and on to Mars.

The center's Engineering Directorate currently is repairing and upgrading the annex, which is a chilled water plant that also contains boilers necessary to provide hot water to the VAB. The annex also provides a secondary loop of water to several

facilities, including from north of the Logistics Facility to Boeing's Commercial Crew and Cargo Processing Facility. The water also is used to provide the HVAC equipment within the buildings the ability to cool down the facilities.

"The repairs are necessary due to damage from Hurricane Matthew in 2016," said Ismael Otero, NASA senior project manager. "During the storm, the annex's electrical equipment, including the switchgear, was damaged. Water and electricity don't mix."

Upgrades to the facility already were planned, but the storm pushed up the upgrades and made them a repair project. A

supplemental appropriation was approved by Congress in 2017 to address the hurricane damage. Then the decision was made to refresh the design and repair by replacing most of the equipment, including the hot water boilers.

"The complex project includes the phased removal and replacement of existing chillers and switchgear," Otero said. Upgrades completed so far include installation of two 2,500-ton chillers in the annex, but they are not operational yet. Pumps, switchgears and transformers also have been installed. Soon-to-be operational boilers have been installed in the **Launch Control Center**, and Orbiter Processing Facilities 1 and 2. Two more 1650-ton, and one 850-ton chillers will be installed.

Some of the chilled and condenser water piping, primary and secondary pumps and all related accessories will be replaced. New cooling tower spray and bypass valves, fan blades and drive shafts, gear boxes, cooling tower ozone water treatment system, oxygen generator and related equipment already have been replaced.

New construction includes a new building to house electrical equipment. It is now attached to the north side of the Utility Annex. A complete rehabilitation and full upgrade of the operational control room, including all its equipment, will be completed by March 2021.

Work on the annex upgrades is targeted to be completed by February 2022. Sauer is the prime contractor for all of the mechanical work, with several sub-contractors performing the remainder of the upgrades.

"When the repairs and upgrades are completed, the facility will provide an up-to-date, more efficient redundant capacity for all chilled water requirements to 17 facilities," Otero said. "This includes critical processing facilities supporting commercial as well as government space operations efforts in the Launch Complex 39 area."



A technician measures foam insulation inside the Utility Annex near the Vehicle Assembly (VAB) Building at NASA's Kennedy Space Center in Florida on July 24, 2019. Photo credit: NASA/Kim Shiflett



A photograph taken July 24, 2019, shows new air tanks, piping and control panels were installed in the Utility Annex near the Vehicle Assembly (VAB) Building at NASA's Kennedy Space Center. The Utility Annex, which provides 8,000 gallons of chilled water per minute to the VAB and other facilities in the Launch Complex 39 area, is being upgraded and repaired. The facility also contains boilers necessary to provide hot water to the VAB. The center's Engineering Directorate is making the repairs and upgrades to the facility to prepare for the agency's Artemis missions to the Moon and on to Mars. Photo credit: NASA/Kim Shiflett



A view of the inside of the Utility Annex near the Vehicle Assembly Building at NASA's Kennedy Space Center on July 24, 2019. Photo credit: NASA/Kim Shiflett



## Prepping for Propellant Loading Practice for Artemis I

Inside the Multi-Operations Support Building near the Multi-Payload Processing Facility (MPPF) at NASA's Kennedy Space Center in Florida, technicians put on Self-Contained Atmospheric Protective Ensemble (SCAPE) suits inside a changing room on Aug. 16, 2019.

SCAPE technicians are practicing putting on the suits for a test simulation of loading propellants into a replicated test tank for Orion. Exploration Ground Systems is preparing for Artemis I with a series of hazardous hypergol test events at the MPPF. After donning their suits, the technicians will complete a tanking to test the system before Orion arrives for processing.

During preparations for launch, these teams will be responsible for loading the Orion vehicle with propellants prior to transportation to the Vehicle Assembly Building, where the spacecraft will be secured atop the Space Launch System rocket. SCAPE suits are used in operations involving toxic propellants and are supplied with air either through a hardline or through a self-contained environmental control unit.

Photo credit: NASA/Isaac Watson

# NASA's Kennedy Space Center Innovators' Launchpad: *Kevin Grossman*



Kennedy Space Center's Kevin Grossman is working on technology and systems that will one day be on the Moon and Mars. Photo credit: NASA/Kim Shiflett

## *Please explain your job in a single sentence.*

I do research on new technologies to use lunar and Martian regolith, or dirt, for applications like construction, metals and oxygen extraction, and radiation protection for humans, which supports our **Artemis program** to return people to the Moon by 2024, where we'll take what we learn there and go to Mars.

## *What do you find most exciting about your job?*

I really enjoy the excitement of being able to shape the architecture of human expansion farther into the solar system. Imagining the **technology** and systems I've worked on being on the Moon and Mars one day really motivates me.

## *What is a typical day like for you?*

A large portion of my day is spent reading up on current state-of-the-art technologies and research articles related to systems that I'm trying to develop. Understanding what's currently being used is the first step toward creating something revolutionary or modifying the technology to be used in space. Another big portion of my day is spent in a lab, either building prototypes or running tests.

## *Was the work you did your first month at NASA anything like your current work?*

My main focus has stayed the same. I have been working on the molten regolith electrolysis system for converting **lunar** and **Martian** regolith into gaseous oxygen and metals and testing it with regolith simulants. This process involves heating the regolith above 1,600 degrees Celsius, which is over 3,000 degrees Fahrenheit, and applying electrodes to separate the metal atoms from the oxygen atoms in the oxide powders in the regolith. I am still working on developing this system along with other projects in the field of in-situ resource utilization (ISRU).

## *What is your educational background and why did you choose to study those areas?*

I have a bachelor's degree in physics from The College at Brockport in upstate New York. My high school physics class sparked an

interest in studying physics in college. After graduating and spending a year teaching high school physics in Orlando, I decided to go to graduate school at the University of Central Florida where I discovered the wide field of materials science. I graduated with my doctorate in materials science in December 2018. Materials science is a very wide-ranging field that applies to almost any engineering project.

## *What motivated you to want to work for NASA?*

Being a part of **the legacy NASA has** of inspiring the country to achieve the impossible is an amazing opportunity.

## *Why does conducting research and developing new technology matter to you?*

Technology development is crucial for enhancing people's lives. Things like automobiles, cell phones, indoor plumbing, medicines, etc., have all been developed as a way to improve people's lives, and these advancements wouldn't be possible without scientific research.

## *How do you think your NASA research or the agency as a whole benefits people on Earth?*

NASA's fingerprints are on so many everyday things that we may take for granted but were developed by NASA and for the space program. Camera phones, memory foam, wireless headsets, LED lights and CT scans are some of the products that were produced as offshoots of **technologies developed for the space program**.

## *Do you have any advice for people trying to foster innovation in the workplace?*

Understand the problem you're trying to solve before making a solution, and do not rush yourself or others to make creative solutions.

# KSC and Proud to Be



*"We've done some amazing things here at NASA ... and they're really all based on our people. And what we've learned over the years is that we are much stronger when we open our minds to diverse thought."*

*Ronnie Rodriguez  
Deputy Director, Safety and Mission Assurance*

## Award-winning filmmaker addresses growing concerns with bias

BY JIM CAWLEY

Directing and producing documentaries has taken Robin Hauser to the White House, Capitol Hill and conferences worldwide. On Aug. 20, 2019, it took her to Kennedy Space Center in Florida, where she discussed the far-reaching effects of bias in today's society — particularly in technology.

During research and interviews for her award-winning documentary "Bias," released last year, Hauser set out to gather as much information as she could about unconscious bias and how it can be mitigated. Believing that all humans have at least some sort of bias, she originally thought artificial intelligence (A.I.) could be the answer.

"But what I learned shocked me," Hauser said during her presentation at the "KSC and Proud to Be" event in the Operations Support II building. "It turns out that artificial intelligence is already becoming biased."

While malicious intent does exist, Hauser believes lack of foresight or carelessness are more often the culprits. By using skewed or imperfect data, biased algorithms can be programmed by well-intended programmers. Hauser suggested it is crucial to have a diverse data set.

Hauser cited a case involving an extremely successful, high-profile company that experienced the negative effects of faulty A.I.

In developing an interior hiring tool to weed through applications, programmers taught the computer to look at the main qualities of the company's top employees. Based on the fact that most of the company's top employees were men, the computer started excluding female applicants.

A.I. also has been linked to racial bias. An example is facial recognition, which has had issues misidentifying people, particularly those with darker skin, Hauser said. What about healthcare? If A.I. diagnoses diseases in certain types of people, will computers become biased based on this information? Will the data be skewed toward people with higher income as a reflection of those who use healthcare more often? These are questions Hauser continues to ask.

"It seems to me that a lot of these new apps, there is this race for the bleeding edge," Hauser said. "You think about the FDA — if you're coming out with a new drug, it has to go through all sorts of regulation and testing. With technology, we don't have that. With technology, you can create an app, and just throw it out there and see if it sticks."

So what can be done?

"I think we need to regulate data input; we need data to be fair and accurate," Hauser said. "And I think we need to govern ethical standards of artificial intelligence."



Above: Jessica Conner, special emphasis program manager, Office of Diversity and Equal Opportunity, helped develop a new employee video focusing on the importance of employee resource groups at the center. The video made its debut showing at the "KSC and Proud to Be" event. Photo credit: NASA/Frankie Martin

Below: Robin Hauser, a director and producer of award-winning documentaries, delivers a presentation during the "KSC and Proud to Be" centerwide diversity event held at Kennedy Space Center's Operations Support Building II on Aug. 20, 2019. Hauser, who has spoken at the White House and at conferences worldwide, addressed bias in artificial intelligence. Photo credit: NASA/Frankie Martin



Above: Kennedy Space Center Director Bob Cabana, left, presents well-known documentary filmmaker Robin Hauser with a token of appreciation during the "KSC and Proud to Be" centerwide diversity event on Aug. 20, 2019. The plaque was made from glass that was a part of Kennedy's Launch Control Center during the Apollo and Space Shuttle programs. Photo credit: NASA/Frankie Martin

Ultimately, A.I. bias is really about human bias, Hauser said, suggesting that we all look inward to determine our responsibility. Hauser experienced that challenge firsthand during the filming of "Bias." In talking to people from all walks of life, she learned that we can identify bias in friends, family and others but have an extremely difficult time seeing it in ourselves.

"That means we need to count less on our own gut — I'm suggesting that you question your gut," Hauser said. "It might be right, but make sure it's based on something that really matters. Consult with people around you. Talk to diverse people around you."

Hauser's presentation was followed by the debut showing of a new employee video focusing on the importance of employee resource groups (ERGs) at the center. Civil servants and contractors throughout Kennedy came together to strongly support the message

of diversity and inclusion at the agency.

"It was exciting to see the teamwork that made this video successful," Kennedy Special Emphasis Program Manager Jessica Conner said. "We all need to recognize, respect and value the similarities and differences within our workforce, and be proactive at making KSC the best inclusive workplace," Conner said.

The event was sponsored by NASA's Office of Diversity and Equal Opportunity, in partnership with the diversity council, which has members from all nine Kennedy ERGs and is chaired by Center Director Bob Cabana.

"I think we have by far the best ERG program within NASA here at the Kennedy Space Center," Cabana said. "I hope all of you are as proud to be a member of the KSC team as I am. I can't think of any place I would rather be or any team I would rather work with."

A panel discussion regarding NASA's Moon to Mars plans took place at Kennedy Space Center in Florida on Aug. 28, 2019. Seated from left, are Tom Joyner, national radio host and panel host; Charlie Bolden, former NASA administrator and astronaut; Kim Carter, Exploration Ground Systems associate manager, technical; Barbara Brown, Kennedy chief technologist; former astronaut Winston Scott; and panel co-host Sybil Wilkes. Photo credit: NASA/Kim Shiflett

Inset: During a recent visit to Kennedy Space Center, Tom Joyner, right, radio personality, met with Kennedy Director Bob Cabana. At left is Sybil Wilkes, Joyner's radio co-host. Cabana took the group on a tour of the Astronaut Crew Quarters inside the Neil Armstrong Operations and Checkout Building, and reflected on his personal experiences suiting up as an astronaut in the historic facility. Photo credit: NASA/Derrick Matthews



## Rotation, Processing and Surge Facility Ready for Artemis I

BY LINDA HERRIDGE

The **Rotation, Processing and Surge Facility** (RPSF) at NASA's Kennedy Space Center in Florida will receive the solid rocket booster segments for final assembly of NASA's **Space Launch System** (SLS) rocket. The agency's **Exploration Ground Systems** (EGS) team successfully completed the system acceptance review and operational readiness review for the facility on July 25, 2019. This review evaluated the RPSF's readiness to receive, process, integrate and launch flight hardware for **Artemis I** and beyond.

"The RPSF is the first processing facility at Kennedy to reach operational readiness status, and our team is looking forward to the arrival of the flight hardware so we can get to work preparing for the Artemis I launch," said Mike Chappell, EGS associate program manager with lead contractor, Jacobs.

When the **booster** segments arrive at Kennedy, the pieces are inspected before two 200-ton cranes are positioned to lift the segments from a horizontal position to a vertical position. The RPSF also will receive the booster aft skirt from the Booster Fabrication Facility. During processing, the aft segment is attached to the aft skirt and aft exit cone.

All of the SLS solid rocket components processed in the RPSF will be transported to the **Vehicle Assembly Building** for final assembly with the SLS core stage and Orion spacecraft on top of the mobile launcher for the agency's Artemis missions.

The RPSF is part of the **infrastructure** at Kennedy that will help NASA launch the Artemis missions and send the first woman and next man back to the Moon by 2024.

Technicians watch as a crane and special mechanism begin breakover, or flipping, of the mated Thrust Reaction Structure and the Guidance Control Assembly for the Orion Program's Ascent Abort-2 flight test during practice, or pathfinder activities, June 22, 2018, inside Exploration Ground Systems' Rotation, Processing and Surge Facility high bay at NASA's Kennedy Space Center in Florida. Many pathfinder tests were completed on the flight hardware in preparation for the flight test. Photo credit: NASA/Ben Smegelsky



## SpaceX, NASA coordinate crucial astronaut recovery exercise

BY JIM CAWLEY

Teams from NASA and SpaceX practiced removing astronauts from a Crew Dragon spacecraft on Aug. 13, 2019, at Port Canaveral in Florida, preparing for when humans return to Earth from a mission to the **International Space Station** as part of **NASA's Commercial Crew Program**.

The joint simulation involved a mock-up of the spacecraft and *Go Searcher*, one of the SpaceX ships that will recover the spacecraft and astronauts after splashing down in the Atlantic Ocean. NASA astronauts **Doug Hurley** and **Bob Behnken**, who will fly to and from the space station aboard Crew Dragon for the SpaceX Demo-2 mission, participated in the exercise.

"Integrated tests like today's are a crucial element in preparing for human spaceflight missions," Hurley said. "This opportunity allowed us to work with the recovery team and ensure the plans are solid for the Demo-2 mission."

The event marked the first time a fully integrated NASA and SpaceX team worked together on the ship to go through an end-to-end practice run of how the teams will recover and extract the astronauts when they return from the space station in Crew Dragon. Hurley and Behnken were taken out of the spacecraft, given a mock medical evaluation and then transported to the Cape Canaveral Air Force Station Skid Strip, or airport.

"We're making sure that the team integrates together — that's a key to any successful mission," said Ted Mosteller, the NASA recovery director in charge of the agency's team for the Commercial Crew Program. "We worked on successfully doing what we need to do to take care of the crew once they return to Earth."

The purpose of the exercise, Mosteller pointed out, was to ensure participants knew their roles and responsibilities — and where they were supposed to be staged on the 150-foot vessel. He was extremely pleased with the results.

"It feels really good; it has been a lot of hard work to get us to this point," Mosteller said. "There was a lot of collaboration, and it was a very positive experience for the integrated team."

For Hurley and Behnken, it's another milestone on the path to their historic flight.

"We are both looking forward to the Demo-2 flight and having the opportunity to return to the International Space Station," Behnken said. "Each of these exercises puts us one step closer to fulfilling NASA's mission of returning astronauts to the International Space Station from U.S. soil."

As commercial crew providers Boeing and SpaceX begin to make regular flights to the space station, NASA will continue to advance its mission to go beyond low-Earth orbit and establish a human presence on the Moon with the ultimate goal of sending astronauts to Mars.

NASA astronaut Doug Hurley, along with teams from NASA and SpaceX, rehearse crew extraction from SpaceX's Crew Dragon, which will be used to carry humans to the International Space Station, on August 13, 2019 at the Trident Basin in Cape Canaveral, Florida. Photo Credit: NASA/Bill Ingalls

Right: NASA astronauts Doug Hurley, left, and Bob Behnken work with NASA and SpaceX teams during an astronaut recovery exercise in Port Canaveral, Florida. Photo Credit: NASA/Bill Ingalls



## Appreciation ceremony recognizes NASA mentors and summer Interns

BY LINDA HERRIDGE

Every year, students and educators from around the United States arrive at NASA's Kennedy Space Center in Florida to work as interns during the summer months. They work in all of the directorates and programs at the center as either **Pathways** interns, or as **NASA Internship and Fellowship (NIF)** interns, from May to August.

This year, about 160 students spent their time working and learning in fields of interest usually related to their college major. They were matched with NASA employees who served as their mentors. They worked alongside full-time employees in nearly all of the center's programs and directorates.

"NASA's mentoring and internship programs are an incredibly important part of building NASA's next generation workforce," said Shawn Quinn, director of Engineering. "I was both an intern and mentor and have observed the benefits of the programs over several years."

At the end of the summer intern cycle, a Mentor Appreciation Ceremony was held Aug. 8, 2019, to recognize all of the mentors and the interns. The Mentor of the Year and Intern of the Year for the Pathways and NIF programs were recognized during an awards presentation.

Mai Miller, with APACHE-LOGICAL, provides support for recruitment and the Pathways Program in Human Resources. She said summers are always exciting for the two internship programs. "We do a combined intern team building event every semester. The interns are doing incredible work at Kennedy," Miller said. "Our Pathways interns are civil servants starting on their first day and are truly NASA's future workforce."



Jill Giles, center, received NIF Mentor of the Year. She is surrounded by some of the students who nominated her for this award. Photo credit: NASA/Kenny Allen



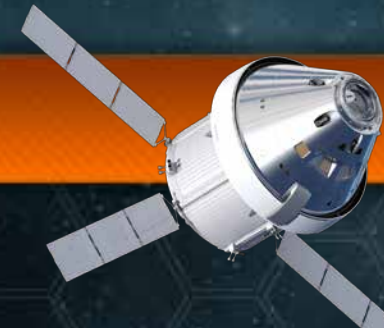
Savannah Lawson, center, received NIF Intern of the Year recognition. Photo credit: NASA/Kenny Allen



Steven McConnell, center, received the Pathways Mentor of the Year award. Photo credit: NASA/Kenny Allen



Triston Cadena, second from right, was recognized as the Pathways Intern of the Year. Photo credit: NASA/Kenny Allen



Kathleen Wilcox, also with APACHE-LOGICAL, is a program project coordinator for NIF in the Academic Engagement Office of the Communication and Public Engagement Directorate. "We had a cheerful, friendly group that was very eager to learn and participate in all things NASA and Kennedy," Wilcox said. "Many of our interns were able to see rocket launches and participate in Apollo 50th anniversary events. They bring new ideas and energy to their teams."

Jill Giles, lead Software Systems engineer in the Engineering Directorate, received NIF Mentor of the Year recognition. She was nominated by several of the students that she mentored.

Stephen McConnell, Environmental Control and Life Support Systems lead test engineer, was recognized as the Pathways Mentor of the Year. He works in the Exploration Division, Environmental and Life Support Systems Branch in the Engineering Directorate.

NIF Intern of the Year was Savannah Lawson. She currently is pursuing a Bachelor of Science in industrial process engineering from the University of South Carolina. Lawson said it is a specialized program that combines mechanical engineering with aspects of a business degree.

Pathways Intern of the Year was Triston Cadena. He is pursuing a master's degree in business administration and management from the University of North Alabama.

"The mentors and interns at NASA today will help return NASA astronauts to the Moon-what an amazing future," Quinn said.

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Apollo 11 astronauts, from left to right, Edwin E. Aldrin Jr., Lunar Module pilot; Michael Collins, Command Module pilot; and Neil A. Armstrong, commander, show a two-pound Moon rock to Frank Taylor, then director of the Smithsonian Institution in Washington, D.C., on Sept. 15, 1969. The first public display of a lunar rock was unveiled at the Smithsonian in the Art and Industries Building on Sept. 17, 1969. The rock was picked up from the Moon's surface during the Extra Vehicular Activity of Aldrin and Armstrong following the first Moon landing. The Apollo 11 mission launched from NASA's Kennedy Space Center in Florida on the Saturn V launch vehicle on July 16, 1969, and safely returned to Earth on July 24, 1969. Photo credit: NASA

National Aeronautics and Space Administration

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