



KENNEDY SPACE CENTER'S  
SPACEPORT  
m a g a z i n e

"The future doesn't  
belong to the fainthearted,  
it belongs to the brave."  
- President Ronald Reagan

FOREVER  
REMEMBERED

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To tell the complete shuttle story that includes the losses of 14 courageous astronauts and the nation's first two shuttles, Columbia and Challenger, NASA and the astronauts' families have collaborated to create a new, permanent memorial designed to honor the crews, pay tribute to the spacecraft and emphasize the importance of learning from the past. "Forever Remembered" opened June 27 inside the Atlantis exhibit at the Kennedy Space Center Visitor Complex. The memorial contains the largest collection of personal items of both flight crews as well as recovered hardware from both Challenger and Columbia, never before on display for viewing by the public. Photo credit: NASA/Kim Shiflett

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## NASA'S LAUNCH SCHEDULE

**Date:** July 3, 12:55 a.m. EDT  
**Mission:** Progress 60P Cargo Craft  
**Description:** In early July, the Progress 60P resupply vehicle — an automated, unpiloted version of the Soyuz spacecraft that is used to bring supplies and fuel — launches to the International Space Station.  
<http://go.nasa.gov/1HUAYb0>

**Date:** July 22, 5:02 p.m. EDT  
**Mission:** Expedition 44 Launch to the ISS  
**Description:** In late July, Kjell Lindgren of NASA, Kimiya Yui of JAXA and Oleg Kononenko of Roscosmos launch aboard a Soyuz spacecraft from the Baikonur Cosmodrome, Kazakhstan to the space station.  
<http://go.nasa.gov/1BspAy1>

**Date:** No Earlier Than Aug 8  
**Mission:** Jason-3 (NOAA)  
**Description:** Jason-3, a mission led by the National Oceanic and Atmospheric Administration, or NOAA, is the latest in a series of U.S.-European satellite missions that have been measuring the height of the ocean surface for 23 years.  
<http://go.nasa.gov/1G4cWwu>

**Date:** No Earlier Than August  
**Mission:** HTV5 Cargo Craft With CALET and MUSES  
**Description:** The H-II Transfer Vehicle (HTV) is JAXA's unmanned cargo transfer spacecraft that delivers supplies to the space station. CALorimetric Electron Telescope (CALET) is an astrophysics mission. Multi-User System for Earth Sensing (MUSES) is a precision-pointing platform that will mount externally to the space station.  
<http://go.nasa.gov/1NqBnDv>



## SHUN FUJIMURA

I am an education specialist in the Education Projects and Youth Engagement Office. I work to inspire students to pursue science, technology, engineering, mathematics, or STEM, careers and with teachers to better integrate STEM into the classroom. Before working at Kennedy Space Center, I was in the Air Force as a satellite engineer and love being able to take the technical lessons I learned and incorporate them into the classroom. I currently am in the Pathways intern program working toward a Ph.D. in science education from the Florida Institute of Technology. I also am in the Florida Air National Guard as a space operator.

The most exciting part of my job is being able to share my passion for space and aeronautics. I have lived and breathed space ever since I saw the movie "Apollo 13" in middle school. From that day, I read many books and watched as many movies about space and airplanes that I could. I have wanted to be a part of the NASA team for a long time. On most days, I still can't believe my dreams have become a reality. Being able to work for NASA *and* be an educator is just icing on the cake. I am proud to represent NASA and look forward to sharing our future endeavors with the next generation of scientists, engineers and explorers!



# Forever Remembered

## Solemn exhibit shares enduring lessons of Challenger, Columbia

BY ANNA HEINEY

The Space Shuttle Program story is full of spectacular successes. From its maiden voyage in 1981 to its final touchdown in 2011, the capable, reusable delta-winged vehicle captivated a generation. Teams of astronauts pulled off seemingly impossible feats in Earth orbit while a cast of thousands supported them from the ground.

But the shuttle story also includes the losses of 14 courageous astronauts and the nation's first two shuttles, Columbia and Challenger. The tragedies galvanized the agency to learn from these painful events, not only to safely return the shuttle fleet to flight, but to help assure the safety of future explorers.

NASA and the astronauts' families have collaborated to create a new, permanent memorial designed to honor the crews, pay tribute to the spacecraft and emphasize

the importance of learning from the past. "Forever Remembered" opened June 27 at the Kennedy Space Center Visitor Complex, where it completes NASA's 30-year Space Shuttle Atlantis exhibit.

Encompassing nearly 2,000 square feet, the memorial contains the largest collection of personal items of both flight crews. It also includes recovered hardware from both Challenger and Columbia, never before on display for viewing by the public.

Family members were present at a small ceremony Saturday as the memorial was formally opened by NASA Administrator Charles Bolden and Kennedy Space Center Director Bob Cabana, both veteran shuttle astronauts.

"The crews of Challenger and Columbia are forever a part of a story that is ongoing,"

Bolden said. "It is the story of humankind's evolving journey into space, the unknown, and the outer-reaches of knowledge, discovery and possibility. It is a story of hope."

Temperatures at Kennedy Space Center were just a few degrees above freezing on the morning of Jan. 28, 1986, as Challenger lifted off on its 10th mission, STS-51L. One minute and 13 seconds into the flight, a booster failure caused an explosion that destroyed the vehicle, resulting in the loss of the crew of seven astronauts: Commander Francis Scobee, Pilot Michael J. Smith, Mission Specialists Judith Resnik, Ellison S. Onizuka and Ronald McNair, and Payload Specialist Gregory B. Jarvis and Christa McAuliffe, a New Hampshire schoolteacher.

Seventeen years later, on Jan. 16, 2003, NASA's flagship orbiter Columbia thundered into orbit on STS-107, a 16-day science



At left: Astronaut artifacts line the walls of a new, permanent memorial, "Forever Remembered," which opened June 27 in the Space Shuttle Atlantis exhibit at the Kennedy Space Center Visitor Complex. NASA and astronaut families collaborated on the memorial designed to honor the crews lost on missions STS-51L and STS-107, pay tribute to shuttle vehicles Challenger and Columbia, and emphasize the importance of learning from the past. Encompassing nearly 2,000 square feet, the memorial contains the largest collection of memorabilia and personal items of both flight crews. It also includes recovered hardware from both Challenger and Columbia, never before displayed for the public. Photo credit: NASA/Kim Shiflett

Above: Ilan Ramon, payload specialist on space shuttle mission STS-107, is remembered through artifacts and personal items in the new "Forever Remembered" memorial. Photo credit: NASA/Kim Shiflett

mission. On board were Commander Rick Husband, Pilot Willie McCool, Payload Commander Michael Anderson, Mission Specialists Kalpana Chawla, David Brown and Laurel Clark, and Payload Specialist Ilan Ramon, Israel's first astronaut. On Feb. 1, 2003, the orbiter broke apart in the skies above east Texas as it re-entered Earth's atmosphere on the way to a planned landing at Kennedy. Seven more lives were lost.

"I believe that it's important to share this story with everyone, and not just push it aside, or try to hide it," Cabana said. "These crews and these vehicles are part of who we are as an agency, and a nation. They tell the story of our never ending quest to explore, and our undying spirit to never give up."

"Forever Remembered" is designed to be an emotional experience,

according to NASA's Mike Ciannilli, who has been NASA's lead on the memorial project since it began about four years ago. At the time, Ciannilli was a NASA test director and landing recovery director.

"Emotion is timeless," Ciannilli explained. "It's important that we don't lock this experience into a certain time, a certain place."

"I knew it would be very emotional to see, but honestly, I didn't expect to be so impacted by it. I just can't stop thinking about it. As you walk in, you know you're in a special place," Evelyn Husband Thompson said of the memorial. Her husband, Rick, commanded Columbia on STS-107.

Visitors enter the memorial through a doorway flanked by the STS-51L and STS-107 mission patches. The orbiter and crew are remembered through individual collections lining the walls: Challenger on the left, Columbia on the right. The items were carefully chosen to share each astronaut's passions, talents and achievements, allowing their personalities to shine through.

Husband's cowboy boots and Bible. A small aircraft Smith hand-carved for his wife. Anderson's vintage Star Trek lunch box. A research paper authored by Judy Resnik, displayed alongside sheet music for violin and piano. There are flight jackets, family photographs and numerous other artifacts offering a glimpse into the people behind the names on the mission patches. Many items were loaned by the

Artifacts representing Ronald McNair, who served as a mission specialist on space shuttle mission STS-51L, are displayed in a new, permanent memorial, "Forever Remembered," in the Space Shuttle Atlantis exhibit at the Kennedy Space Center Visitor Complex. Photo credit: NASA/Kim Shiflett





A section of the fuselage recovered from space shuttle Challenger, left, and the flight deck windows recovered from space shuttle Columbia are part of a new, permanent memorial, "Forever Remembered," which opened June 27 in the Space Shuttle Atlantis exhibit at the Kennedy Space Center Visitor Complex. Photo credit: NASA/Kim Shifflett

families; others belong to NASA.

"The families have been unbelievably gracious, inspiring, warm and giving," Ciannilli said. "There were times they provided comfort to me as I worked on this, and still do."

At the end of the first hall, the warmth of the astronauts' collections gives way to a small gallery where guests will see firsthand the toll these events took on the shuttle hardware. A section of Challenger's fuselage displaying the American flag stands at left; on the right, the flight deck windows of Columbia are placed at eye level.

"When I look into those windows, I see John Young and Bob Crippen preparing to launch on the boldest test flight in history, the first flight of America's space shuttle, Columbia," Cabana said. "I see a much younger Bob Cabana launching to space on his first command, and I see Rick and Willie and the rest of the (STS-)107 crew smiling and experiencing the wonders of space on the final flight of Columbia."

While great care has been taken to preserve the pieces, they're real, bearing the scars of the trauma each shuttle endured.

"It's a beautiful remembrance of all

***"I believe that it's important to share this story with everyone, and not just push it aside, or try to hide it."***

Bob Cabana, director, Kennedy Space Center

the shuttles, with the marvelous display of Atlantis. Nothing compares to it in the world," said June Scobee Rodgers, whose husband, Dick Scobee, commanded Challenger on STS-51L. "But Challenger and Columbia are not forgotten, and they're well represented."

But that is not where the story ends.

"Forever Remembered" concludes with a focus on the recovery and return-to-flight efforts, including the emotional toll these events had on the nation, the challenges involved in recovery, and the triumph of return to flight. A looping video shares heartfelt letters written by children as they shared their condolences and messages of hope.

After each loss, investigators spent months looking at recovered hardware, poring over

data and conducting analysis to determine what had gone wrong. A second video reveals rarely seen photos and footage of this painstaking process.

The space shuttle team pulled together to fix the problems and return the program to flight each time. Any less effort would not have honored the fallen astronauts or their missions. Shuttle Atlantis, on display nearby, flew the final mission of the Space Shuttle Program, STS-135.

That determined spirit is alive in every launch. In a sense, every flight is a return to flight — another opportunity to build upon success and experience.

"The artifacts here on display are not easy to look at. Many of them are on display for the very first time," Bolden said. "It is our hope that by making them available for the public to view, we will help remind the world, that every launch, every discovery, every measure of progress, is possible only because of the sacrifice of those we have lost."

Among McAuliffe's artifacts is a quote: "I touch the future. I teach."

The lessons of Challenger and Columbia will endure as we continue to reach for the stars.

## Recognizing Excellence



NASA employees from across the agency converged on Kennedy Space Center for the 2015 Agency Honor Awards Ceremony on June 2. In total, 25 individuals were recognized by NASA Administrator Charlie Bolden at the ceremony and given either the Distinguished Service Medal or Distinguished Public Service Medal. These medals are NASA's highest form of recognition awarded to a government and non-government employee who, by distinguished service, ability, or vision has personally contributed to NASA's advancement of United States' interests. The individual's achievement or contribution must demonstrate a level of excellence that has made a profound or indelible impact on NASA mission success, and therefore, the contribution is so extraordinary that other forms of recognition by NASA would be inadequate. This year, Kennedy Space Center had two such individuals who received this prestigious award.

SCOTT WILSON received the medal for his continued distinguished service over several years providing outstanding production operations management for the success of the Exploration Flight Test-1 launch.

AMANDA MITSKEVICH was given the medal for distinguished and exemplary service in establishing the Launch Services Program as the leader in commercial launch services for the agency.

Amanda Mitskevich, Launch Services Program manager, is presented the Dr. Kurt H. Debus Award by Mark Jager, National Space Club Florida Committee Chairman on April 18. She earned the prestigious award for her significant contributions to the space industry in Florida and active engagement in community service as an advocate and supporter of space.

Photos courtesy of Abacus Technology

# Look Online

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When NASA's Low-Density Supersonic Decelerator test vehicle flew high over the Pacific Ocean June 8 to test two innovative aerobraking technologies, it did so thanks to the tenacity and ingenuity of workers at a host of NASA facilities, military installations and specialized companies that very nearly stretches from sea to shining sea.

The LDSD flight tested breakthrough technologies for landing future robotic and human missions on Mars and safely returning large payloads to Earth. During the flight test off the coast of Hawaii, researchers lofted the test vehicle to 120,000 feet via a large NASA scientific balloon. A powerful rocket then boosted it another 60,000 feet up, before sending it hurtling toward the ocean below — simulating the supersonic speeds at which the craft would travel through Mars' atmosphere.

This second full-scale flight test — the first took place in summer 2014 — was a crucial milestone for proving two key technologies. The first is its supersonic inflatable aerodynamic decelerator, or SIAD, a balloon-like pressure vessel with a diameter of nearly 20 feet, designed to inflate around a vehicle and slow its entry. The second is a state-of-the-art supersonic parachute 100 feet in diameter, designed to further reduce the vehicle's speed during atmospheric descent.

Watch video of the test:  
<https://www.youtube.com/watch?v=7ksgMkDeLoM>



Above: This artist's concept shows the test vehicle for NASA's Low-Density Supersonic Decelerator, designed to test landing technologies for future Mars missions. A balloon lifts the vehicle to high altitudes, where a rocket takes it even higher, to the top of the stratosphere, at several times the speed of sound. Image credit: NASA

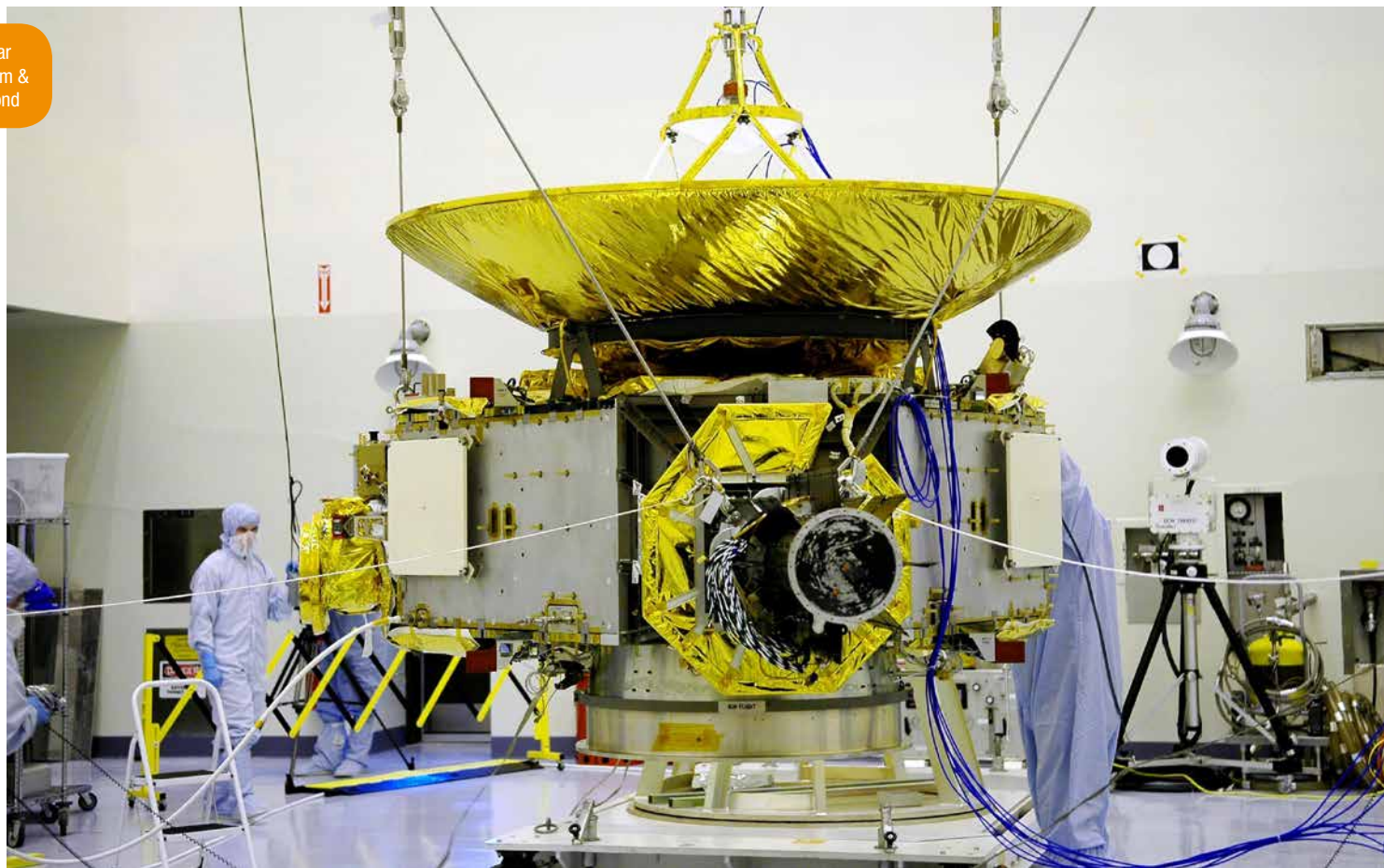
Left: NASA's Jet Propulsion Laboratory LDSD Project Manager Mark Adler, left, and LDSD Project Principal investigator Ian Clark inspect the test vehicle May 28, at the U.S. Navy's Pacific Missile Range Facility, in Kauai, Hawaii. Photo credit: NASA

# UNPRECEDENTED CHALLENGES

## Flyby will provide best ever view of Pluto

BY BOB GRANATH

Solar System & Beyond



The New Horizons probe is moved toward a work stand for a checkout on Sept. 25, 2005, in Kennedy Space Center's Payload Hazardous Servicing Facility. The 1,054-pound, piano-sized spacecraft is topped by a high-gain dish antenna to transmit data across three billion miles back to Earth. Photo credit: NASA

NASA's New Horizons mission presented challenges like no other, but its goal also was unprecedented. The spacecraft will soon begin a study of the farthest reaches of the solar system. It was an historic journey of more than 3.6 billion miles that began at the agency's Florida spaceport.

Plans call for New Horizons to send the first-ever, close-up images and scientific observations of distant Pluto, its system of large and small moons, and the Kuiper Belt. A region of the solar system beyond the

planets, the Kuiper belt consists mainly of small planetary bodies.

To reach its primary target, the New Horizons spacecraft has traveled farther away and a longer time — more than nine years — than any previous space mission. The flight through the Pluto system is planned to begin July 14, 2015. It will complete the initial reconnaissance of the classical solar system, expanding the frontiers of knowledge, capability and opportunity in space.

Alan Stern, Ph.D., New Horizons

principal investigator, recently spoke to several hundred Kennedy Space Center employees, many of whom helped process and launch the first Pluto probe.

"For all of you who worked on this, thank you very much; it worked flawlessly," said Stern, who is associate vice president for Research and Development at the Southwest Research Institute, or SwRI, in Boulder, Colorado. "For the whole scientific community, for our science team, for our mission team, and for all the people who

worked this, a big round of applause to all of you."

The New Frontiers project was approved in June 2001 with the mission profile proposed and the spacecraft built by a team led by Stern and including researchers from SwRI and the Johns Hopkins University Applied Physics Laboratory, or APL, in Laurel, Maryland.

Early in the process, the New Frontiers team contacted representatives of NASA's Launch Services Program, or LSP, at the Kennedy Space Center.

"Soon after the mission was approved, we began discussions about what would be the best launch vehicle to provide the needed energy to send the spacecraft at unprecedented speeds and distances," said Mike Stelzer, who was LSP's mission manager for New Horizons. "We selected the Atlas V rocket to give us the needed boost for a 1,054-pound, piano-sized spacecraft at the speed necessary for a three-billion-mile trip."

The chosen version of the Lockheed Martin Atlas V used five strap-on solid rocket boosters, more than any previous launch. Added to that was a powerful Centaur upper stage.

"And all of that was still not enough," said Stelzer, who now works in the Vehicle Integration and Launch Support Branch of Kennedy's Ground Systems Development and Operations Program. "To get that needed additional push to achieve the required 'escape velocity,' we added the upper stage of a Boeing Delta II rocket."

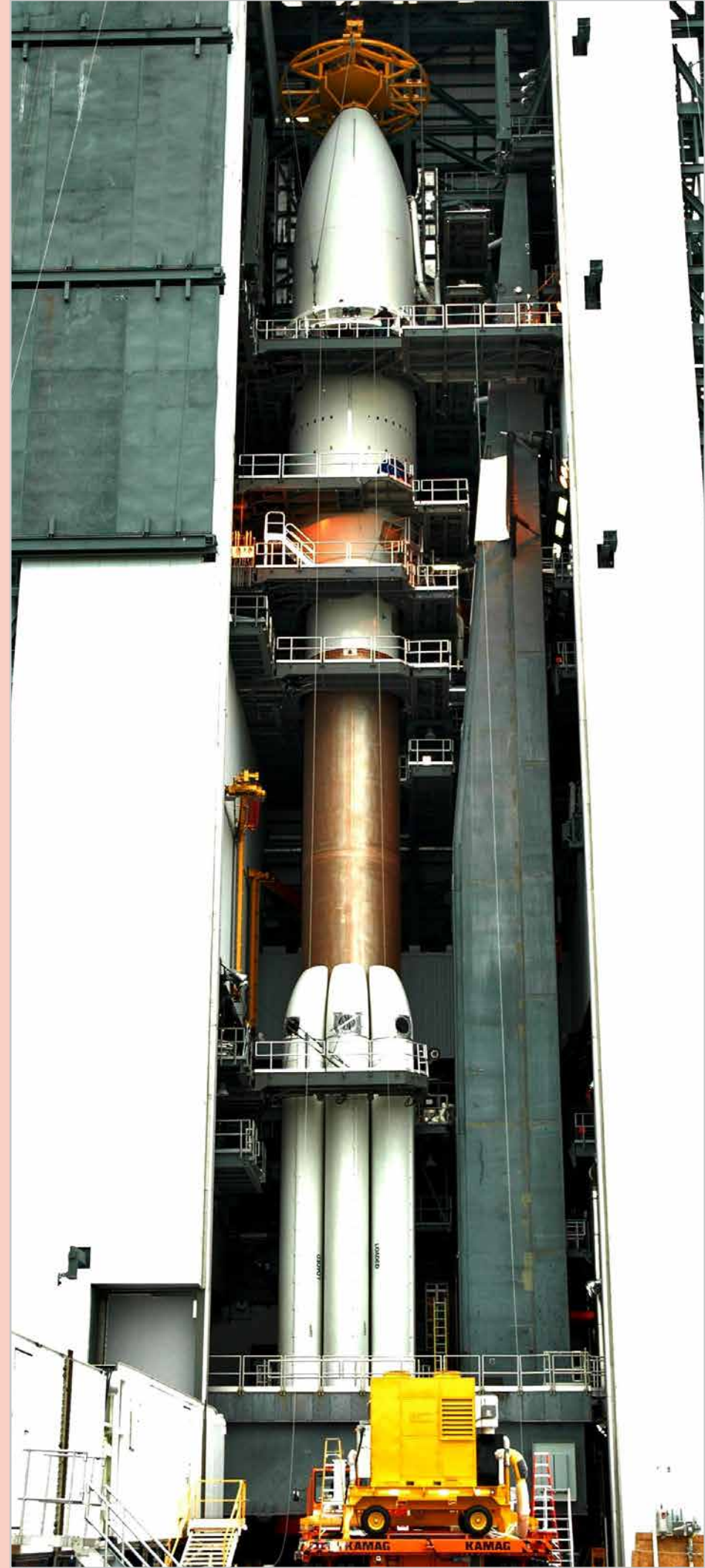
According to Chuck Tatro, who was the New Horizons launch site mission manager for LSP, additional effort was needed to coordinate the many organizations involved.

"Ordinarily, mission meetings involve 30 to 40 people," he said. "For this, progress reviews frequently included 50 to 60 and sometimes as many as 100."

In addition to NASA, support came from SwRI, APL, Lockheed Martin, Boeing, the Idaho National Laboratory, and representatives from the New Horizons Program Office at the Marshall Space Flight Center in Alabama.

"It was a challenge to coordinate that many roles in the project," said Tatro who currently is chief of the Launch Site Integration Branch of LSP, "but since we were sending a probe to an unexplored planet, it was an exciting time."

Enclosed in its payload fairing on Dec. 17, 2005, the New Horizons spacecraft is mounted atop its Lockheed Martin Atlas V rocket in the Vertical Integration Facility at Launch Complex 41 at Cape Canaveral Air Force Station. Photo credit: NASA





NASA's New Horizons spacecraft roars off Cape Canaveral's Launch Complex 41 atop an Atlas V rocket Jan. 19, 2006. Photo credit: NASA

New Horizons was transported by a U.S. Air Force C-17 cargo plane arriving at Kennedy's Shuttle Landing Facility on Sept. 24, 2005.

"It was about 9 or 10 p.m. that night and everyone was pretty enthusiastic," Tatro said. "Sending a probe to Pluto had been a dream for a long time, and now the spacecraft was at the last stepping-off point before that long journey began."

After New Horizons was unloaded, it was transported to the center's Payload Hazardous Servicing Facility, or PHSF, for preflight preparations.

Stelzer explained a careful focus of preflight processing was the Pluto probe's power source.

"Traveling as far away from the sun as New Horizons did, means solar panels are useless," he said. "Batteries and fuel cells also wouldn't work due to the length of the mission. That meant using a radioisotope thermoelectric generator, or RTG."

An RTG is an electrical generator that uses an array of thermocouples to produce electricity through the heat released by the decay of a suitable radioactive material, in this case plutonium. The unit for New Horizons was developed by the U.S. Department of Energy at the Materials and Fuels Complex, a part of the Idaho National Laboratory.

"We made sure the design and configuration was well vetted to ensure the RTG was safe," Stelzer said.

While the spacecraft was being processed in the PHSF, the launch vehicle was being prepared at Cape Canaveral Air Force Station.

The Atlas V booster and Centaur second stage arrived at the Cape Skid Strip in late August 2005. Both were processed in the Atlas Space Operations Center. On Sept. 29, 2005, the first stage of an Atlas V rocket was raised to vertical on Launch Complex 41 at the Cape and the Centaur added shortly thereafter. Preparations for launch continued in the 30-story Vertical Integration Facility (VIF) with attachment of the five solid rocket motors.

This is where the New Horizons team



On June 2, 2015, Kennedy Space Center employees heard a panel discussion with key individuals who supported the New Horizons mission to Pluto. From the left are, New Horizons Principal Investigator Alan Stern, Ph.D., of the Southwest Research Institute; Si Song, Lockheed Martin's third stage integrator for the Atlas V, now the Spacecraft Integration lead for United Launch Alliance; and Chuck Tatro, the New Horizons launch site mission manager for NASA's Launch Services Program, now chief of the Launch Site Integration Branch of LSP. Moderating the discussion, on the far right, is George Diller of Kennedy's Communication Office. Photo credit: NASA/Kim Shifflett

faced their next challenge.

"Hurricane Wilma blew through while we were stacking the rocket," Stelzer said. "Part of a door tore off in the high winds and hit one of the solids."

Wilma crossed Florida on Oct. 24, 2005. The highest wind gust recorded at the spaceport was 94 mph, while the maximum sustained wind was 76 mph. A portion of a 41-by-275-foot reinforced fabric "megadoor" on the VIF blew off, causing some debris to impact a solid rocket booster. Lockheed Martin technicians replaced the damaged solid-fuel booster.

"They did a great job recovering from the storm and that kept us on schedule," Tatro said. "From the beginning of the project, we were on a tight timeline to take advantage of a brief lineup of Earth, Jupiter and Pluto."

The launch window extended from Jan. 11 to Feb. 14, 2006. However, launching within the first 23 days would allow New Horizons to swing past Jupiter for a gravity assist that would speed the travel to Pluto. Although there were backup launch opportunities in February 2006 and February 2007, any launch outside the primary period would have forced the spacecraft to fly a slower trajectory directly to Pluto, delaying its encounter by five to six years.

A gravity assist maneuver puts a spacecraft in a trajectory close enough to a planet to use its gravity. This alters the probe's path in a "slingshot maneuver" to change speed saving propellant and travel time.

On Dec. 17, 2005, Tatro took a last look at New Horizons just

before it was encapsulated in its payload fairing.

"It looked like a big grand piano, with the RTG stuck out to one side, topped off by a big seven-foot, high-gain dish antenna," he said. "It is an elegant spacecraft."

After the New Horizons spacecraft with its Delta II Star 48 third stage kick motor was transported from the PHSF to Launch Complex 41, it was mounted atop the booster rocket.

Lockheed Martin's Si Song was the third stage integrator for the Atlas V. He monitored the final countdown from the launch control center of the Atlas Spaceflight Operations Center at Cape Canaveral just four miles from pad 41. He still remembers the emotions of the moment.

"I had two thoughts going through my mind," said Song, now the Spacecraft Integration lead for United Launch Alliance. "One was, this is going to be the fastest man-made object in the solar system once it gets off its rocket. The second thing was that this is the last time that any human is going to see the spacecraft before it started on its three-billion-plus-mile journey to the edge of our solar system. It was really exciting and it almost brought tears to my eyes."

Launched from Cape Canaveral on Jan. 19, 2006, New Horizons received a gravity assist from Jupiter during its closest approach in 2007. That increased the probe's speed by 9,000 mph, successfully shortening its voyage to Pluto. New Horizons' closest approach will be July 14, 2015, later passing Pluto's largest moon, Charon.

"This is one of the more memorable things that has happened in our time," Stern said, "the exploration of our solar system."

# Pluto Probe

## New Horizons spacecraft sets sights on most distant planet

BY BOB GRANATH

NASA's New Horizons spacecraft soon will pass through the outer edges of the solar system. After a nine year and more than 3.6 billion mile trip, plans call for the probe to provide the first close up observations of Pluto and the most distant objects in the solar system.

Lifting off from Cape Canaveral Air Force Station on Jan. 19, 2006, New Horizons has traveled a longer time and farther away than any previous space mission to reach its primary destination, Pluto and the Kuiper Belt.

"Of course we've seen it before, but we've

never see it like we're going to see it on July 14," said NASA Deputy Administrator Dava Newman during a recent visit to Kennedy Space Center.

On June 2, New Horizons principal investigator Alan Stern, Ph.D., spoke to Kennedy Space Center employees, providing a preview of what to expect when the spacecraft makes its closest approach to Pluto on July 14, 2015.

"It's an epic journey across the solar system," said Stern, who is associate vice president for Research and Development at the Southwest Research Institute, or SwRI, in

Boulder, Colorado.

The New Frontiers spacecraft was built by a team led by Stern and included researchers from SwRI and the Johns Hopkins University Applied Physics Laboratory, APL, in Laurel, Maryland. APL also operates the New Horizons spacecraft and manages the mission.

"Nothing like this has happened since the Voyager program launched in 1977," said Stern.

During the mid-1960s, the United States and Soviet Union began sending probes to the planets closest to Earth — Venus and Mars. However, it was not until the 1970s

This artist's concept depicts the New Horizons spacecraft during its planned encounter with Pluto and its moon, Charon. The craft's cameras, science experiments, ultraviolet and infrared spectrometers and space plasma experiments will characterize the geology, surface compositions, temperatures and atmosphere of both Pluto and Charon. Photo credit: Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute.

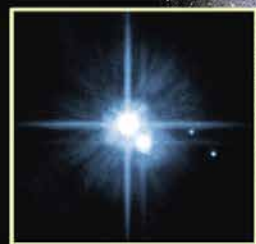
### Reconnaissance at the Farthest Frontier

KBOs  
2016–2020

Pluto System  
July 2015

Jupiter System  
Feb 2007

Launch  
Jan 2006



This illustration notes that New Horizons was launched in January 2006, passed Jupiter in February 2007 and will make its closest approach to Pluto with its eccentric orbit (noted in yellow) during July 2015. During the next five years, the spacecraft will enter the zone of KBOs, or Kuiper Belt Objects. Often called the "third zone" of the solar system, the Kuiper Belt swirls beyond both the inner zone of rocky planets (Mercury, Venus, Earth and Mars) and the middle zone of the gas giants (Jupiter, Saturn, Uranus and Neptune). The Kuiper Belt is the largest structure in the solar system, holding an estimated 100,000-plus miniature worlds, many with diameters no larger than 62 miles. Image credit: NASA





that spacecraft were being launched toward Mercury, Jupiter and Saturn. The most significant step was Voyager 2, also referred to as the “Grand Tour.” Launched from Cape Canaveral in 1977, it passed Jupiter in 1979, Saturn in 1981, Uranus in 1986 and Neptune in 1989.

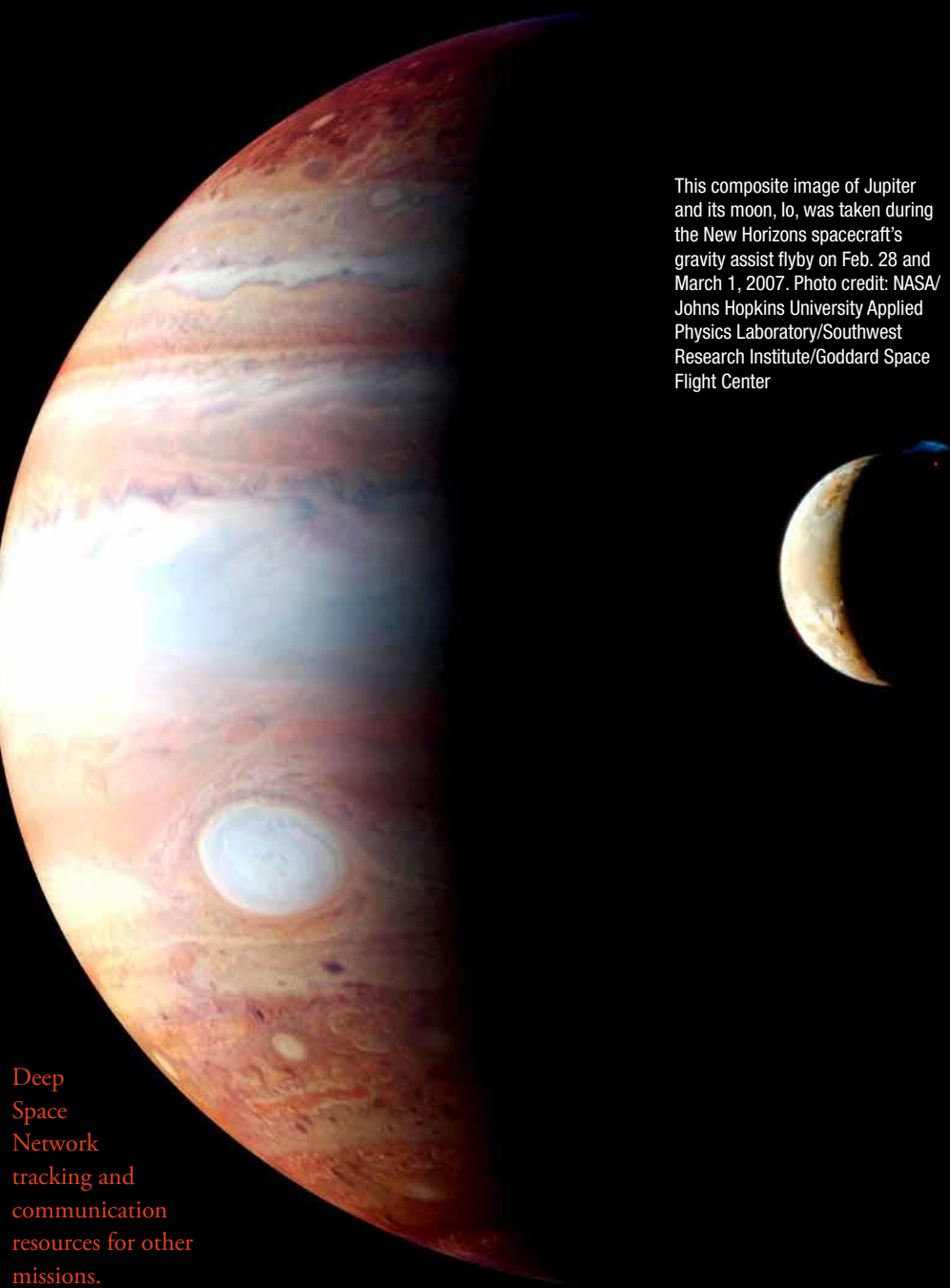
“I’m particularly proud of the tradition that began in 1962 with Mariner to Venus,” said Stern, a former associate administrator for NASA’s Science Mission Directorate. “The United States was first to every planet in the solar system. Centuries from now people will read about how, in one short period of time, a little over 50 years, we started from scratch eventually exploring across the solar system. But, we have a bit of unfinished business. New Horizons is going to complete that.”

New Horizons launched from Cape Canaveral on Jan. 19, 2006 directly into an Earth-and-solar-escape trajectory. After the spacecraft separated from its third stage solid-fuel kick motor 44 minutes, 53 seconds after launch, the Pluto probe was on its way at 36,373 mph. With that velocity, it needed only nine hours to pass through the moon’s orbit.

The planet Jupiter provided New Horizons with a gravity assist when it passed within 1.4 million miles on Feb. 28, 2007. A gravity assist maneuver puts a spacecraft in a trajectory close enough to a planet to use its gravity. This alters the probe’s path in a “slingshot maneuver” to change speed saving propellant and travel time.

The Jupiter flyby increased New Horizons speed, accelerating the probe to 51,000 mph and shortening its voyage to Pluto by five to six years.

During the Jupiter encounter, New Horizons trained its science instruments on the large planet and its moons. After that, Chuck Tatro, who was the New Horizons launch site mission manager for LSP, explains the spacecraft was placed in “electronic hibernation” for much of the trip to Pluto. New Horizons pioneered routine cruise-flight hibernation. Not only has it reduced wear and tear on the spacecraft’s electronics, it lowered operations costs and freed up NASA



This composite image of Jupiter and its moon, Io, was taken during the New Horizons spacecraft’s gravity assist flyby on Feb. 28 and March 1, 2007. Photo credit: NASA/ Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute/Goddard Space Flight Center

Deep Space Network tracking and communication resources for other missions.

“Throughout the almost nine-year trip, flight controllers would ‘wake up’ New Horizons once every year to confirm the health of the spacecraft and perform any needed course corrections,” he said. “It was brought out of its final hibernation period on Dec. 6, 2014 to prepare for the Pluto encounter this summer.”

When New Horizons’ closest approach to Pluto begins, the probe will perform a flyby during which it will attempt to take detailed measurements and images of the small planet and its moons.

“It will whiz by Pluto,” said Tatro, who currently is chief of the Launch Site

Integration Branch of LSP. “The fly-by will last only eight to 10 hours. We’ll be receiving the bulk of the data during a period of about 24 hours.”

Due to the 3.625-billion-mile distance, it will take about four-and-a-half hours for the signals to reach Earth with the long-awaited information.

“The closest approach period really starts around the first of the month, (July 2015) and goes for several weeks,” Stern said. “About 900 scientific



Alan Stern, Ph.D., principal investigator for the New Horizons mission describes expectations for the probe’s fly-by of Pluto. He currently is associate vice president for Research and Development at the Southwest Research Institute in Boulder, Colorado. Photo credit: NASA/Kim Shiflett

observations will be taking place.”

New Horizons is intended to pass within 6,200 miles of Pluto, at about 7:50 a.m. EDT on July 14. The spacecraft will have a relative velocity of 30,800 mph at its approach and will come as close as 17,000 miles to Pluto’s largest moon, Charon.

“This is true exploration,” Stern said. “We’re going to write the book on Pluto.”

Planetary scientists believe Pluto is primarily made of rock and ice and is relatively small, about one-sixth the mass of the moon and one-third its volume.

“Pluto is about the size of the United States,” Stern said. “Charon is about the size of Texas.”

Charon has a diameter of slightly more than half of Pluto with the two sometimes described as a binary system. This is because the barycenter of their orbits do not lie within either body. The International Astronomical Union, IAU, has yet to formalize a definition for binary dwarf planets and Charon is still officially classified as a moon of Pluto along with Nix, Hydra, Kerberos and Styx.



When the New Horizons spacecraft was launched, Pluto was still classified as a planet, later to be reclassified as a dwarf planet by the IAU. Stern disagrees with that definition and still describes Pluto as a planet.

“We’re just learning that a lot of planets are small planets and we didn’t know that before,” he said. “Fact is, in planetary science, objects such as Pluto and the other dwarf planets in the Kuiper Belt are considered planets and called planets in everyday discourse in scientific meetings.”

**“Of course we’ve seen it before, but we’ve never seen it like we’re going to see it on July 14.”**

**Dava Newman, NASA Deputy Administrator**

Pluto’s orbital period is 248 Earth years and its orbital characteristics are substantially different from those of the planets. From Mercury to Neptune, the other bodies circle the sun following nearly circular, almost flat, orbits. In contrast, Pluto has an eccentric and highly inclined orbit that takes it from 2.8 to 4.6 billion miles from the sun. Hence, Pluto periodically comes closer to the sun than Neptune, but their orbital resonance prevents the bodies from colliding.

Tatro noted that for the past nine years, Pluto’s 3.625-billion-mile distance from the sun gives a rare opportunity to determine the

nature of any atmosphere.

“Due to this ‘relative closeness’ to the Sun, scientists feel this provides the best hope of detecting any type of atmosphere around Pluto,” he said. “This is because of the sun’s weak heating at this ‘closer’ distance.”

After its flyby of Pluto, New Horizons may also open the door to an entirely new zone of mysterious small planets and planetary building blocks in the Kuiper Belt, a large area with numerous objects beyond Neptune’s orbit.

“Gerard Kuiper, who was a leading 20th century planetary scientist, believed that the reason Pluto looked like a misfit was that our technology was not good enough to find things orbiting with it,” Stern said.

The Kuiper Belt is a region of the solar system beyond the planets, extending beyond the orbit of Neptune. It is similar to the asteroid belt, but it is much larger -- 20 times as wide and 20 to 200 times as massive. Like the asteroid belt, it consists mainly of small bodies, or remnants from the solar system’s formation.

By expanding the frontiers of knowledge, capability and opportunity in space, NASA hopes to better understand the farthest reaches of the solar system, answering questions about Earth and life beyond.

“The universe has a lot more variety than we thought about and that’s wonderful,” Stern said. “The most exciting discoveries will likely be the ones we don’t anticipate.”



Federal Engineer of the Year Award nominees from Kennedy Space Center, Brad Lytle, left, and Phil Weber, display their award plaques in front of the new scale model of NASA's Space Launch System and Orion spacecraft on the mobile launcher inside the IMAX theater at Kennedy Space Center Visitor Complex. Photo credit: NASA/Kim Shifflett

# SIMPLY...THE BEST

## Kennedy engineers named two of nation's best

BY FRANK OCHOA-GONZALES AND LINDA HERRIDGE

The Federal Engineer of the Year Award, sponsored by the Professional Engineers in Government, honors engineers employed by a federal agency that employs at least 50 engineers worldwide. Kennedy's Brad Lytle and Phil Weber were two of the 25 engineers honored at the ceremony in Washington, D.C.

A panel of judges from the National Society of Professional

Engineers in Government evaluates engineers based on factors such as engineering achievements, education, professional and technical society activities, awards and honors, and civic and humanitarian activities. Of the 25 honorees, 10 finalists were chosen before the ceremony and then finally a "Federal Engineer of the Year" was selected — a lieutenant colonel from the Air Force was chosen.

## Brad Lytle

Engineer Brad Lytle has 34 years of experience working with cranes and critical material handling, including 14 major crane projects at NASA's Kennedy Space Center. But it was his work on the refurbishment of the Vehicle Assembly Building's 175-ton crane that hoisted him as one of the top 25 Federal Engineers of the Year.

"I have always felt that I have been given a hard job and an important job," Lytle said. "But it's very important to note that I am one person on a larger team and it is an honor for me to represent this team."

The 175-ton bridge crane in High Bay 3 is 50 years old and one of the original VAB cranes that dates back to the Apollo era. The crane had some modifications and upgrades so it can support lifting needs for future exploration vehicles, including NASA's Space Launch System (SLS) and Orion spacecraft.

"This project was sorely needed," Lytle said. "The project entails a modernization and complete replacement of all the control systems."

The crane was reinstalled on the VAB crane rails June 3. The team took an old dinosaur of a crane and made it into a modern crane with a state-of-the-art enhanced safety control systems. The crane eventually will be used for lifting the back end of the SLS Core Stage in the VAB for stacking on the mobile launcher. The new control system provides a very fine speed and motion control suitable for the core stage handling.

"We were driven to develop a rather innovative set of platforms for SLS that can be easily reconfigured to support a variety of SLS vehicles or other vehicles all from the same set of platforms in the same VAB High Bay," Lytle said. "These platforms are very expensive so outfitting just one high bay can really save some money in the long run."

Lytle also was part of the team that designed the VAB High Bay 3 Platforms. The old space shuttle access platforms were removed to make room. Lytle also worked on many cranes that involve flight hardware material handling including the Rotation Processing Surge Facility 200-ton cranes, Orbiter Processing Facility-3 30-ton cranes, the VAB 325-ton cranes and the Space Station Processing Facility 30-ton cranes.

"I would be remiss if I did not say that team work is how you get major projects like this done," Lytle said. "You will not find a harder working or more talented group of people. We are now in the construction phase and we are seeing all this design and planning work become reality."

Since 1986, Lytle has been involved in Codes and Standards work for the American Society of Mechanical Engineers.

"This experience has been invaluable to me Lytle said, "Over the years I served as committee secretary, subcommittee chairman, committee vice chairman and chairman. The code and standards work has enabled me to become the crane engineer that's needed for this job."

Lytle attended then-Brevard Community College and the University of Florida and graduated with a Bachelor of Science degree in mechanical engineering in 1980. He earned his professional engineering license in 1985. He moved from Huntsville, Alabama when he was 10 and has lived on the Space Coast ever since.

## Phil Weber

It's really by chance that Phil Weber ended up working for NASA at Kennedy Space Center. Hailing from the small farm town of Glasgow in the northeast corner of Montana, Weber's journey took him a long way from his hometown. But it's a choice he's never regretted.

This seasoned mechanical engineer has seen a lot of changes during his 30-year career at the center. Weber has worked in several major NASA programs, including space shuttle, Constellation, and orbital space plane. He also helped establish the Spaceport Range and Technology Directorate during a reorganization in 2000, all leading up to his current role as senior technical integration manager for the Ground Systems Development and Operations Program at Kennedy.

Weber is responsible for technical decisions and approving the program technical baseline. He also is the GSDO Program Review Board chairperson and works with other NASA centers, including Headquarters, Johnson Space Center in Houston, and Marshall Space Flight Center in Huntsville, Alabama, to help prepare for the launch of NASA's Space Launch System (SLS) and Orion spacecraft on Exploration Mission-1 (EM-1), targeted for 2018.

"Kennedy Space Center is the hub where it will all come together," Weber said. "As we work through the ongoing technical challenges, the goal is the same for all of us."

One of the challenges he recently worked to resolve was a technical issue with the SLS tail service mast umbilical that will connect to the core stage for fueling the rocket. Kennedy is designing the ground piece and MSFC is designing the flight hardware. During analysis, it was discovered that the loads were very high in the quick disconnect that will disengage before launch. Weber worked with a cross-program team, including representatives from NASA's SLS Program, Boeing, Kennedy's Engineering Directorate, and engineers on the Engineering Services Contract, to find the best solution to reduce the loads.

"We have a solution, a redesign fix in place," Weber said. "The hardware will start arriving in December and testing of the umbilical will begin early next year here at the Launch Equipment Test Facility."

Weber said the next three years will be the most exciting of his career at Kennedy and he is looking forward to the EM-1 launch.

"Phil is an exceptional engineer and leader," said Jennifer Kunz, GSDO deputy program manager. "We are fortunate to have him leading our technical team as we transform Kennedy to launch the world's most powerful rocket."

Some of his accomplishments included, managing \$2.5 billion for the development of ground systems needed to process and launch SLS, Orion and future space payloads being developed for human exploration of deep space. Also, leading cross-program integration activities that are instrumental to NASA and the Exploration Systems Development (ESD) Division.

Commenting on his nomination, Weber said: "Initially I was shocked and then I felt very humble. I was very grateful to my manager Jennifer Kunz for the nomination. And then, to go to the Grand Ballroom at the National Press Club in Washington, D.C., with my wife — what a journey from a small farm town in Montana."

# Advanced Technology

## Morpheus team completes ALHAT system tests on prototype lander

BY LINDA HERRIDGE

NASA's Project Morpheus team of engineers and technicians completed the final series of flight tests on the prototype lander at NASA's Kennedy Space Center. The lander is designed to provide a way to test advanced spacecraft systems that could be incorporated into future spacecraft for exploration missions to the moon, an asteroid or Mars.

Morpheus is a prototype lander that can use advanced sensors to automatically fly and navigate around hazards and land in a predetermined location within a simulated rocky planet environment. This autonomous landing and hazard avoidance technology, or ALHAT, is designed to enable a spacecraft to identify and descend to a safe landing

site that is relatively flat and free of large boulders, rocks and craters. Morpheus also is capable of vertical takeoff and landing using precision landing technologies and a liquid oxygen and liquid methane propulsion system.

In a series of baseline tests, the Morpheus team first evaluated the lander's ability to take off and land without using the ALHAT sensors. Then the team added the ALHAT system to the spacecraft and gradually increased the difficulty of the tests. The final tests utilized the integrated hardware and software updates that were identified as a result of previous testing at the agency's Johnson Space Center in Houston and at Kennedy.

Taking baby steps at first, the team performed several tethered tests with just the lander to check its functionality. The lander was suspended by a crane and the main engine was ignited. The vehicle, attached to the crane by a tether line, rose a short distance, performed a series of maneuvers for about one minute, and then descended to take up the slack in the tether. Results of several tethered tests proved the system was ready for the free-flight phase of the testing.

"The Morpheus/ALHAT free flights at Kennedy are a key step in the development and demonstration of several new technologies for future robotic and human planetary exploration missions," said Edward Robertson, ALHAT deputy project manager

NASA's Project Morpheus prototype lander soars overhead during free flight test No. 15 on Dec. 15, 2014, at the north end of the Shuttle Landing Facility at Kennedy Space Center. During the 97-second test, onboard autonomous landing and hazard avoidance technology sensors, or ALHAT, surveyed the hazard field for safe landing sites, then guided the lander forward and downward to a successful landing. Photo credit: NASA

at Johnson Space Center in Houston.

From December 2013 to December 2014, Morpheus completed 13 free flight tests at the north end of Kennedy's Shuttle Landing Facility, with seven of them occurring to demonstrate lander performance without ALHAT, and the remaining 6 with ALHAT installed. A transportable, concrete launch pad was constructed and a flame trench was added, prior to this series of tests, to help reduce the effects of harsh noise and vibrations on the lander during a launch.

ALHAT's three sensors scan for rocks, craters, and excessively sloped areas, all hazards to the lander, and relay safe landing information to Morpheus. The three main sensors are a laser altimeter and Doppler Light Detection and Ranging, or LIDAR, velocimeter — both used for navigation — and a flash LIDAR-based hazard detection system

The system autonomously selects its landing target, modifies the route and lands the vehicle in the safest area as analyzed by

the sensor package. Following the integration of ALHAT, free-flight tests were performed, with the Morpheus vehicle soaring higher and traveling farther, always touching down within inches of its intended safe-zone target in the hazard field.

The team took a 6-month testing hiatus to review flight data and make improvements.

"We continued to maintain a constant dry-air purge on the flash LIDAR sensor to prevent damage to the array from high humidity," said Greg Gaddis, the Morpheus/ALHAT site manager at Kennedy. "We also had to recertify the liquefied natural gas and the liquid oxygen tankers for use."

Gaddis said the team also performed a load test of the crane hardware that would lift Morpheus into the air, recertifying it for use in preparation for the tether tests.

The final series of tests was completed at Kennedy in late 2014 to verify its autonomous liftoff and landing capabilities and hazard detection ability. The action took place at the north end of the landing

facility, using the same hazard field that was used to test ALHAT. The vehicle's three-beam Doppler velocimeter sensor used for navigation was moved from the left rear quadrant to the front of the vehicle's forward oxygen tank to eliminate interference from the engine plume and surrounding heated air that was seen in previous free-flight testing. Navigation software also was reformulated in preparation for the first closed-loop ALHAT flight. A closed-loop flight means that ALHAT alone would actually fly the lander to the newly designated safe landing zone without assistance from the control center as was used in previous tests.

Following a successful data and test readiness review, Morpheus Project Manager Jon Olansen, based at Johnson, declared the lander was ready for the next step, a Hazard Detection Phase free-flight, to test the ALHAT upgrades.

After a series of weather delays, Morpheus successfully completed its final free-flight test. The vehicle flew on closed-loop ALHAT



NASA's Project Morpheus prototype lander comes to rest after a successful landing in the hazard field, capping free flight test No. 15 on Dec. 15, 2014, at the north end of the Shuttle Landing Facility at Kennedy Space Center. Photo credit: NASA



navigation using its upgraded sensor suite during the entire flight, traversed above the hazard field, then softly touched down within about four feet of the targeted landing location.

“The ALHAT team reviewed the data and determined the navigation performance was successful and satisfied the Technology Readiness Level objective of the flight-test campaign,” said Olansen.

Upon reviewing all of the free-flight test data, the team agreed that the Morpheus/ALHAT project had met the objectives identified. These included achieving precision landing, certifying flight software and high-fidelity simulation, the development and successful operation of a liquid oxygen (LOX)/liquid methane propulsion engine feed system and tanks, integrating the vehicle, and evaluating ground systems and operations.

“We believe the cumulative testing has satisfied the intent of demonstrating integrated LOX-methane propulsion capabilities and ALHAT closed-loop performance in a relevant dynamic flight environment,” Olansen said.

After completion of the tests at Kennedy, the team removed the ALHAT sensor system from Morpheus, packed it, and shipped it back to Langley Research Center in Hampton, Virginia, while the Morpheus vehicle and ground support equipment were returned to Johnson.

Project Morpheus is managed under the Advanced Exploration Systems Division in NASA’s Human Exploration and Operations Mission Directorate. Morpheus and ALHAT are examples of the partnerships that exist within the agency since eight of the 10 NASA centers contributed time, energy and resources to both.

An engineer makes an adjustment to the ALHAT sensors on NASA’s Project Morpheus prototype lander Dec. 11, 2014, in preparation for free flight test number 15 at the north end of the Shuttle Landing Facility at Kennedy Space Center. Photo credit: NASA/ Jim Grossmann



Engineers and technicians prepare NASA’s Project Morpheus prototype lander for free flight test No. 15 on Dec. 14, 2014, at the north end of the Shuttle Landing Facility at Kennedy Space Center in Florida. Photo credit: NASA/Jim Grossman



# Look Online

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NASA inspires and educates future scientists, technologists and engineers by engaging them in science, technology, engineering and mathematics, or STEM, activities and learning opportunities. Among the different ways to meet the challenge is to provide grants for education programs.

The Ground Systems Development and Operations, or GSDO, Program at Kennedy Space Center did just that by providing \$25,000 in grants to support some existing For the Inspiration and Recognition of Science and Technology, or FIRST, teams and helping create several new teams in Brevard County. GSDO also provided guidance and support to the teams.

The FIRST Robotics mission is to inspire young people to be science and technology leaders, and engage them in exciting mentor-based programs that build STEM skills, inspire innovation and help foster self-confidence, communication and leadership. GSDO helps teams in three of the four FIRST programs: FIRST Lego League, FIRST Tech Challenge and FIRST Robotics Competition.

For the complete story, visit:  
<http://go.nasa.gov/1AQ3Vot>

# Fired Up

## New multi-use Firing Room 4 used for RESOLVE mission simulation

BY LINDA HERRIDGE

NASA's 21st century multi-user Firing Room 4 in the Launch Control Center at Kennedy Space Center was used for the first time June 3. The facility last used to launch space shuttle Atlantis on the STS-135 mission in July 2011 was the site of a multi-center integrated mission simulation for the Regolith and Environment Science and Oxygen and Lunar Volatiles Extraction, or RESOLVE, team.

RESOLVE is a miniature drilling and chemistry plant about the size of an extra-large suitcase that will be installed on a medium-sized lunar rover. It is a component of the Resource Prospector that is targeted to launch in 2020 on a mission to the polar region of the moon. RESOLVE's instruments will be used to map the distribution of volatiles and collect and analyze soil below the surface for volatile components such as water or hydrogen that could be used in human exploration efforts.

"We are the first customer to take advantage of this low-cost, multi-use facility," said Josie Burnett, director of Kennedy's Exploration Research and Technology Programs. "Customizing our own control room isn't just cool, it enables us to enhance our exploration training."

The team is using the firing room for about six months to support operations.

Steve Cox is an operations engineer in the Ground Systems Development and Operations, or GSDO, Program. He oversaw the firing room modifications and provides support to the LCC



A simulation test of the RESOLVE payload June 3 was the first use of one of the new 21st century multi-user control rooms inside Firing Room 4 in the Launch Control Center at Kennedy Space Center. Photo credit: NASA/Ben Smegelsky

and the end-to-end command and control development group.

During the shuttle era, the firing rooms were designed to support up to 200 people or more. The four smaller control rooms in Firing Room 4 are designed to support smaller missions that may only require 25 to 30 people for a test. As customers' needs grow and they get closer to launch, Cox said opening access to adjoining rooms will accommodate an increased crew size of 50 to 100.

"The four new control rooms are designed for customers who may use the facility for a couple of weeks, a month or all the way up to a year or more," Cox said. "For RESOLVE, we found out what the team's requirements were and then we set up the room to meet their specific needs."

For the RESOLVE team, each of the stations has four monitors and a secure space network for communication with

***"The four new control rooms are designed for customers who may use the facility for a couple of weeks, a month or all the way up to a year or more."***

Stephen Cox, GSDO operations engineer

the other NASA centers.

For the long term, Cox said GSDO will use some of the existing control room equipment, such as networks, cabling, routers, monitors, tables, chairs and conference rooms that already are in place to support other customers' needs.

"There's a wide variety of possible use, and we have to meet customers' needs according to how they want to set up the control room or rooms," Cox said.

"What we really like about Firing Room 4 is that it has a real mission operations feel to

it," said James Smith, lead systems engineer for the RESOLVE payload. "It's a very flight-like environment."

During the simulation, the team communicated with Ames Research Center in Moffett Field, California, which is the flight project office for RESOLVE, and is providing the neutron spectrometer and the Near Infrared Volatile Spectrometer Subsystem, or NIRVSS; Johnson Space Center in Houston, which is providing the Oxygen and Volatile Extraction Node, or OVEN; and the Jet Propulsion Lab in Pasadena, California,



An artist illustration of RESOLVE on the surface of the moon. Image credit: NASA



During the first use of one of the new 21st century multi-use control rooms in Firing Room 4 in the Launch Control Center at Kennedy Space Center, Josephine Santiago-Bond, a system engineer, is stationed at the payload console position June 3 during a simulation test of the RESOLVE payload. Photo credit: NASA/Ben Smegelsky

which is providing support to the Lunar Advanced Volatile Analysis, or LAVA subsystem. Kennedy provides project management for the payload and also contributes the avionics, software and LAVA subsystem to RESOLVE.

“We’re talking with these centers and the hardware they are providing for RESOLVE,” Smith said. “We’re using Firing Room 4 as a mission operations center for the payload.”

Smith said the team will use the firing room for subsequent flight simulations, the flight mission and the entire RESOLVE payload. Using the flight-like environment for the RESOLVE simulation is in line with NASA’s “test as you fly” philosophy.

Even though the hardware will reside at Johnson, Smith said the team will control it from Firing Room 4 at Kennedy during a three-day planned simulation test in August.

RESOLVE is part of the Advanced Exploration Systems Program in the Human Exploration Operations Mission Directorate.

For more information about GSDO, visit <http://www.nasa.gov/groundsystems>.

For more information about Resource Prospector, visit <http://www.nasa.gov/resource-prospector>.

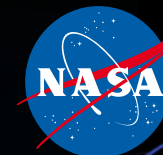
The inaugural use of the Kennedy Space Center’s Launch Control Center was for the liftoff of the first Saturn V on Nov. 9, 1967. During the Apollo 4 countdown, Public Affairs commentator Jack King and other launch team members were operating out of Firing Room 1. They were not sure what to expect when the mighty rocket roared to life with 7.5 million pounds of thrust on a launch pad three miles away.

“The windows in the launch control center just started to rattle,” said King in a 2009 interview with David Waters of Spaceflight Now.com. “And then on top of that, it was a newly constructed building and all of this material — all this dust — came down from the ceiling. I thought the whole place was going to come down on us.”

NASA’s first chief of Public Information, Jack King died June 11, 2015.



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SpaceX CRS-7 lifted off from Space Launch Complex 40 at Cape Canaveral Air Force Station on June 28 at 10:21 a.m. EDT. After liftoff, an anomaly occurred. Photo credit: NASA/Charles Babir

### SpaceX, NASA will rebound from CRS-7 loss

BY STEVEN SICELLOFF

The break-up during launch of a SpaceX Falcon 9 rocket carrying cargo and research payloads to the International Space Station won't deter the nation from pursuing its goals in space exploration near Earth and in deep space, NASA officials and congressional representatives said. Nor will it sideline plans to develop and fly a new generation of American-made spacecraft on missions in the near future to the take astronauts to the station.

"Our nation and citizens all over the world are depending on us to lead in this grand and exciting adventure known as space exploration, and we will not disappoint," said Charles Bolden, NASA administrator. "We will work with and support SpaceX to assess what happened, understand the specifics of the failure and correct it to move forward. This is a reminder that spaceflight is an incredible challenge, but we learn from each success and each setback."

The Dragon spacecraft, launching atop the Falcon 9, carried no crew or astronauts but was loaded with more than 5,000

pounds of experiments, equipment and supplies and included a new docking adapter to be mounted to the station to permit commercial spacecraft carrying astronauts to dock at the orbital laboratory. The mission, known as CRS-7 for the seventh of SpaceX's commercial resupply flights, was lost about 2 minutes and 19 seconds after liftoff from Cape Canaveral Air Force Station when the launch vehicle broke up.

"We are certainly in an extraordinary position to know what happened, to find what happened, to fix what happened and to get back to flight," said Gwynne Shotwell, president of SpaceX. "I'm sure we will find it rapidly. And we will get back to flight as soon as we safely and reliably can."

SpaceX named Hans Koenigsmann, vice president of Mission Assurance for the company, to lead the investigation. There is no word at this time of what caused the accident, but the company has vowed to track down the cause and fix it, then return to launching the Falcon 9. The rocket had enjoyed a healthy string of successful flights dating back to its first flight in 2010 until

this launch, including a test rendezvous and berthing and then six operational cargo delivery missions to the station.

The space station's crew of three astronauts — yearlong-mission astronaut Scott Kelly and Russian cosmonaut Gennady Padalka and Expedition 44 crew member Mikhail Kornienko — are in no danger of running out of food and water and have enough research duties aboard the station to continue their experiments. A second crew of three remain on schedule to launch to the station in July.

"We lost a lot of important research equipment on this flight," said William Gerstenmaier, NASA's associate administrator for the Human Exploration and Operations Directorate. "We lost the docking adapter that we had planned to set us up for later. We will be able to recover from that. I don't want to minimize a loss to us, but from a macro-level standpoint, the crew's in no danger. We can actually learn from this failure, understand a weakness or flaw or design we might not have seen for a while."

# ON DECK

## Backup docking adapter to replace lost IDA-1

BY STEVEN SICELLOFF

The first International Docking Adapter, or IDA, lost on the CRS-7 mission will be replaced with an identical version made from parts already on hand, NASA's space station manager said, so the next generation of American crewed spacecraft will be able to connect to the station in the near future.

Boeing built two docking adapters to be attached to the station to provide a parking place for the company's CST-100 and SpaceX's Crew Dragon which are in development for NASA's Commercial Crew Program. With one lost, the second will be launched on a future mission while a new one is assembled to be flown to the station after that. When completed and in place, the adapters will offer a primary and backup docking position for spacecraft carrying astronauts to the orbiting laboratory.

"Our overall plan is to have two docking ports and go back to what we call direct handover where the replacement crew shows up while the other crew is still on orbit and

they hand over to each other for about a week or so and then the other goes home," said Mike Suffredini, program manager of the International Space Station. "But that's not mandatory. And so, if by the time the commercial crew vehicles start to fly regularly to ISS that will be our path until we get a second IDA up there. We have parts for a third IDA and so we will go look to see how quickly we can assemble that."

The adapters were built to the International Docking System Standard, which features built-in systems for automated docking and uniform measurements. That means any destination or any spacecraft can use the adapters in the future — from the new commercial spacecraft to other international spacecraft yet to be designed. The adapters also include fittings so power and data can be transferred from the station to the visiting spacecraft. The work by private companies to take on low-Earth orbit missions is expected to free up NASA's

resources for future missions into deep space with astronauts in the Orion crew capsule launching on the Space Launch System Rocket to prepare for future journeys to Mars.

"It's really opening up a new era for commercial crew support to ISS," said Mark Ortiz, Boeing's project manager for the two IDAs. "The IDA enables flexibility for multiple commercial and international vehicles to dock to ISS and opens the door to a new international standard."

As was the case with IDA-1, the systems and targets for IDA-2 will be put through extensive tests at Kennedy Space Center's Station Processing Facility before being loaded for launch.

The targets are much more sophisticated than previous docking systems and include lasers and sensors that allow the station and spacecraft to talk to each other digitally to share distance cues and enable automatic alignment and connection. Think of it as a car that can park itself.

"We set the hardware up and had the folks from Boeing and SpaceX come over and do some alignment checks and testing so they would know their systems would work," said Steve Bigos, project manager for orbital replacement unit processing at Kennedy. "There was a lot of new technology, so it was very interesting."

The team then packaged it for launch and put it in the configuration it will need for the ride into space and placement on the station.

VIDEO: ABC's of IDA <https://youtu.be/Z2qtlfuoyig>

Technicians with The Boeing Co. inspect the International Docking Adapter during its assembly at the company's Houston facility. Photo Credit: The Boeing Co.



# HOT! HOT! HOT!

Thermal Protection System Facility keeps up with new vehicles

BY STEVEN SICELOFF

Heat shield tiles are getting stronger to make the next generation of American spacecraft safer as they experience searing heat and plasma on their way back into Earth's atmosphere for landing.

The Thermal Protection System Facility is equipped with a variety of specialized tools to produce the precise tile shapes unique to each spacecraft's design. For the first time since 2011, about 75 media and social media representatives toured the workshop and got a glimpse into how tiles are developed. Demonstrations also were performed, such as how waterproofing tiles protects spacecraft from rain, sleet and snow.

Tiles developed in the facility were used on NASA's Orion spacecraft, which performed its first flight test in December 2014. Data obtained about the thermal protection system during the flight test will help engineers refine the spacecraft's system ahead of its first uncrewed flight, Exploration Mission-1, and first crewed mission to orbit around the moon in the 2020s, preparing NASA for longer journeys to Mars.

Jacobs Technology engineers are producing test samples that will be used to protect the Dream Chaser spacecraft under development by Sierra Nevada Corporation, SNC, in partnership with the agency's Commercial Crew Program. The facility is the same workshop that produced space shuttle heat shield tiles at Kennedy Space Center for more than 30 years.

SNC continues to advance its development of the reusable Dream Chaser spacecraft that launches vertically atop a United Launch Alliance Atlas V rocket and returns to Earth for a runway landing. Like the shuttle, the Dream Chaser will use several kinds of protective materials on the outside of the spacecraft to form a protective barrier. Tiles made from improved silica-based blocks will make up most of the belly and upper portion of the heat shield, while a new material developed at NASA's Ames Research Center called "TUFROC" will cover the nose and leading edges. Those are the surfaces that

must resist and mitigate the highest temperatures the spacecraft experiences from the friction of re-entering Earth's atmosphere. Another factor that makes the tiles desirable for a heat shield: they are mostly air. As a result, the tiles are extremely lightweight, a vital factor for spacecraft design in which weight is the primary driver of launch costs.



At first glance, the white blocks with a Styrofoam texture look no different than the thousands of blocks made for the space shuttle heat shields before being coated with a black ceramic material. But these new blocks incorporate advanced materials, making them stronger while maintaining the capability to prevent searing plasma from jeopardizing a spacecraft or its crew during the hazardous phase of a mission as the crew returns from orbit through Earth's atmosphere on the way to a landing. The nose skid of the Dream Chaser currently is outfitted with thermal protection system tiles to assess performance in preparation for a free-flight test of the spacecraft at the agency's Armstrong Flight Research Center in California, targeted for later this year.



Technicians prepare the slurry used to make a thermal protection system silica-based block in development for Sierra Nevada Corporation's Dream Chaser spacecraft. Photo credit: NASA/Dimitrios Gerondidakis

Sierra Nevada Corporation's Dream Chaser engineering test article is being prepped for its second free-flight test at NASA's Armstrong Flight Research Center in California later this year. The wings, windows and landing gear are all installed. The Dream Chaser's nose skid will have thermal protection system tiles, manufactured at Kennedy Space Center's Thermal Protection System Facility, for the flight test. The performance of the tiles will be assessed following touch down on the runway. The flight test is a milestone under NASA's Commercial Crew Integrated Capability agreement with SNC. Photo credit: Sierra Nevada Corporation



# IN CASE OF EMERGENCY

## MRAP ROLLS THROUGH LAUNCH PAD EVACUATION RUNS

BY STEVEN SICELOFF

NASA has a new set of wheels to get its astronauts and ground operations personnel away from danger at the launch pad and in its first extensive timing tests, the 45,000-pound MRAP armored vehicle showed it's a bit faster than expected.

Engineers from Boeing and NASA's Commercial Crew Program, United Launch Alliance and Special Aerospace Service drove the MRAP, short for Mine Resistant Ambush Protected, on potential emergency routes at Space Launch Complex 41 at Cape Canaveral Air Force Station, to determine how much time to allocate in their contingency plans for launches coming up in 2017.

The planning is required as Boeing works toward certifying its CST-100 spacecraft for flight tests with and without crew from the launch pad. It will be followed later by more simulations and analysis that eventually will include a full rehearsal with slidewire baskets carrying astronauts and ground personnel from the top of the crew access tower now under construction to a spot some 1,300 feet away from the pad. That's where MRAPs will be parked on launch day.

"We were surprised it was faster than we'd calculated," said Brian Pitchford, a senior systems engineer for Special Aerospace Services. "It's not noisy at all, I mean you can carry on fairly regular conversations inside. We've pretty much base-lined what we're going to do as far as evacuating the pad, but for the purpose of completeness we wanted to test various routes that could become primary routes or secondary routes."

Astronauts will climb into vehicles where they can either stay in place, protected by the MRAP's thick hull, or start up the wheeled trucks and drive away from potential danger to an area outside the blast danger area or to a helipad where an injured person could be flown to a hospital or other facility.

"Knowing how long it takes to get a



MRAP is a 45,000-pound armored vehicle used to evacuate astronauts and ground operations personnel from danger at the launch pad. Photo credit: Jim Grossmann

I don't want people climbing up the rear end of the MRAP because of the steps, so we'll design a ramp and they can run up right into the back of it."

Able to drive smoothly at 45 to 50 mph, the MRAP also is considerably faster than the M113 and can be driven like a truck, which means the demands on an astronaut or support staff would be minimized during a stressful evacuation of the launch pad area.

person from the pad to where it will be safe is critical in our risk reduction for the crew," said Steve Payne of Commercial Crew, a former shuttle test director whose launch day responsibilities often included making sure emergency crews and equipment were ready for any countdown and launch situation. "You can draw lines on a map all you want, but until you get out and run the course in real-life conditions, you don't know. You think you know, but you don't know."

The scenario has never played out in real life, but has been planned for since designers started launching humans on top of rockets. A simple crane with a basket was in place for Alan Shepard in case he had to get out of his Mercury capsule in a hurry in 1961, for instance. As the rockets became more robust, planners incorporated faster evacuation methods that included hurried transportation to a bunker for the Saturn V

***"You can draw lines on a map all you want, but until you get out and run the course in real-life conditions, you don't know. You think you know, but you don't know."***

Steve Payne, Commercial Crew Program

and space shuttle. For shuttle, Vietnam War-era M113 armored personnel carriers waited at the bunker in case astronauts needed to get away fast.

The MRAP's armor is so thick that each door weighs 600 pounds and has the sound and feel of a bank vault. So the vehicle can function as a bunker on its own, even if it stays put, said Howard Biegler, United Launch Alliance's project manager for SLC-41.

"It provides some benchmarks and ensures we have the right vehicle for the job and it tells us how quickly we can get out of danger," Biegler said. "Today, I learned that

"I think it'll be exponentially easier to drive than the M113," said Tim Moore, an emergency management specialist with Kennedy's Protective Services who drove the MRAP through the timing runs. "If you can drive a large truck, you can drive one of these."

Moore worked with the Defense Department to transfer a set of surplus MRAP vehicles for NASA's Ground Systems Development and Operations Program, or GSDO. GSDO had the vehicles modified and painted white. NASA will use them for crew emergency operations for the Space Launch System rocket and Orion spacecraft.



MRAP can drive smoothly at 45 to 50 mph. Photo credit: Jim Grossmann

# SEGMENTED STEPS

On May 26, workers assemble two tiers of a crew access tower destined for Space Launch Complex 41 at Cape Canaveral Air Force Station. The tiers are being built in a yard a few miles from the launch pad and will be integrated at the launch site later so as not to interfere with operational launches. Once assembled, the crew access tower will stand about 200 feet and is designed to provide safe access to Boeing's CST-100 spacecraft as it stands on the pad atop a United Launch Alliance Atlas V rocket.

Photo credit: NASA/Jim Grossmann

## New crew access tower takes shape at Cape

BY STEVEN SICELOFF

ISS



The metal segments that will be stacked to form a complete crew access tower later this year are taking shape a few miles from Space Launch Complex 41 at Cape Canaveral Air Force Station. The work by Boeing and United Launch Alliance is critical in readying the launch site for a crew flight test to certify the systems in 2017 for operational missions to the International Space Station for NASA's Commercial Crew Program.

It will take seven tiers, as each segment is called, to form the 200-foot-tall tower that will be mounted beside the Atlas V launch pad already in place at SLC-41. The tower will be outfitted with all the wiring, lines, support facilities, stairs and elevators a space-bound crew and ground support staff require. A set of slidewire baskets will be ready to help people evacuate Boeing's CST-100 spacecraft and tower in a hurry in the unlikely event of an emergency.

"Safety of our NASA astronauts and ground crews is at the forefront as we construct the crew access tower," said Mike Burghardt, the launch segment director for Boeing's Commercial Crew Program. "The crew tower embodies the fact that very soon we'll be launching crew missions again from the Space Coast."

With cranes moving the largest pieces into place, welders and riveters connect the thick steel beams together to form the central spars of the crew access tower. This structure will be expected to withstand the intense liftoff environments of Atlas V rockets. The tiers are being built away from the pad so they won't interfere with the current Atlas V launch schedule. This off-site work allows foundation work at the pad to occur while the tiers take shape. Once the seven tiers are built and outfitted with everything but wire harnesses and elevator rails, they will be trucked over to SLC-41 and stacked between launches.

"This is an extremely exciting time," said Rick Marlette, deputy project manager for ULA's launch pad construction. "It's great to be doing the construction after so many years, and we're bringing Atlas back to its heritage from the Mercury Program of flying astronauts into space."

This will be the first new crew access tower for a vehicle that will carry humans into space from Cape Canaveral since the one built at Launch Complex 34 for Apollo missions in the 1960s. The fixed service structures used for crew access during shuttle launches were built in the late 1970s at Kennedy Space Center.

Once the tower is built, the crew access arm and white room will act as a bridge from the tower to the hatch of the CST-100. They will feature wider passages, stairs and fixtures friendly to the crews who will make their way around the structure in spacesuits. Careful attention is given to details, such as how much fire suppression equipment is needed — sensors and extinguishers — as well as designing routes that prevent teams from getting separated accidentally. These two components will be connected to finish the structure prior to Boeing's crew flight test.

# Green Space

## Innovative thinking converts repair site into garden

BY BOB GRANATH

As an innovative leader in Earth science, NASA encourages its people to find ways to enhance the environment. Earlier this year, Gloria Sylvia saw such an opportunity when water pipes were being replaced in front of the gate to the Vehicle Assembly Building, or VAB. Her efforts to plant a small garden recently were rewarded with the Kennedy Space Center's Catch an Environmentalist Award.

NASA VAB Operations Manager Jim Bolton liked the improvements so much he nominated Sylvia and the F-Gate Garden Team for the recognition honoring their efforts to add plants and grass. The F-Gate includes a small building in which security monitors, such as Sylvia, provide access at the entrance of the facility.

"Gloria is one of the access control monitors here at F-Gate and she took the initiative," he said during a ceremony at the garden. "As the repair workers were finishing the water pipe project, she purchased a few plants on her own, placed them out there with some mulch."

One of the largest buildings in the world, the VAB originally was constructed to support stacking of the Apollo Saturn V rockets that took American astronauts to the moon. The facility later was refurbished to support the 30-year Space Shuttle Program.

NASA now is modifying the facility to accommodate the Space Launch System advanced heavy-lift rocket which will provide a new capability for human exploration beyond low-Earth orbit. As employees come and go through the F-Gate each day, the idea



Frank Kline, NASA's Sustainability Program technical lead at the Kennedy Space Center, left, presents Kennedy's Catch an Environmentalist Award to Gloria Sylvia, center, for her efforts in planting a small garden at the gate to the Vehicle Assembly Building. Also participating is Jacobs Technology Vice President Andy Allen, right, who is general manager of the Test and Operations Support Contract team at Kennedy. Sylvia is an access control monitor for Jacobs. In the background, NASA VAB Operations Manager Jim Bolton uses recycled water from the guard building's air conditioner to irrigate the plants. Photo credit: NASA/Dimitrios Gerondidakis

of making the access more attractive quickly caught on and others wanted to help.

"People started walking by thinking, 'what a cool idea,'" Bolton said. "Quite a few individuals started contributing to the effort."

In addition to the grass sod, plants and mulch, a pair of iconic plastic pink flamingos

and a small garden gnome have been included.

"Ralph Gregory, with Jacobs Technology VAB Operations, bought the gnome," said Sylvia, who works in Security with Jacobs.

"The gnome had been painted to appear to be wearing an Air Force uniform, I repainted it a

bit and made the uniform into an astronaut flight suit."

She also noted that water is captured from the air conditioner on the side of the F-Gate building and recycled.

"We put the condensation in a watering can to irrigate the plants and new grass sod," she said.

Jacobs Vice President Andy Allen, who is general manager of the Test and Operations Support Contract team at Kennedy, congratulated the team effort for initiative, cooperation and pride.

"This kind of esprit should be honored and it is certainly appreciated," said Allen, a former NASA astronaut. "Thanks for coming up with the idea. It looks great."

Frank Kline, NASA's Sustainability Program technical lead at Kennedy, explains that the Catch an Environmentalist Award recognizes individuals and teams that have notably contributed to environmental stewardship at the spaceport.

"Some time ago, the NASA Environmental Office came up with the idea of recognizing ecological efforts that benefit the space center," Kline said as he presented the award plaque. "We think the garden is a great idea and we appreciate all the work."

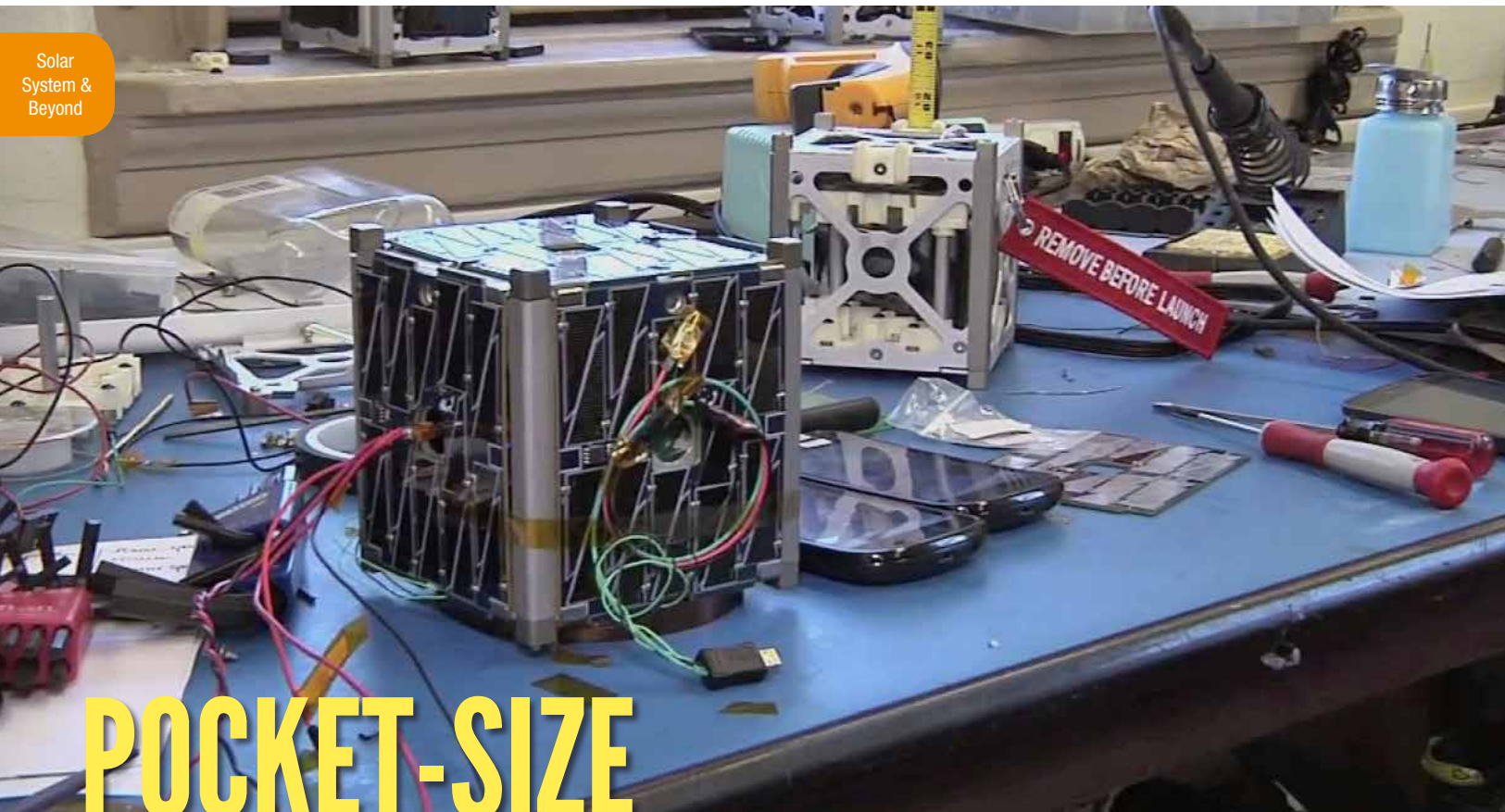
The Catch an Environmentalist Award recognizes performance in several categories: Education and Awareness, Energy Conservation/Renewable Energy, Fuel, Efficiency/Renewable Fuels, Historic/Archeological Preservations, Natural Resources/Habitat Conservation, Sustainable Design/Construction, Sustainable Environment Management Systems, Sustainable Operations, Use of Environmentally Preferable or Recycled-Content Products, Waste Prevention/Reduction/Recycling and Water Conservation.

Any Kennedy employee may recommend someone for the Catch an Environmentalist Award by going to <http://go.nasa.gov/QKqSO2> to nominate an individual or team.

"NASA at Kennedy is at the forefront of sustainability actions for the nation," Kline said. "This recognition effort is an example of taking the lead in honoring those who make the space center and the Earth a better place to live."



Ralph Gregory of Jacobs Technology Vehicle Assembly Building Operations bought the garden gnome. Originally, the gnome's flight suit was olive drab. Gloria Sylvia took it home and painted it blue to resemble an astronaut's flight suit. Photo credit: Jacobs Technology/Gloria Sylvia



# POCKET-SIZE POWER

## NASA issues request for proposals for new class of launch services

BY STEVEN SICELOFF

Satellite designers are being forced to think outside the box by building spacecraft that fit inside a box — a very small box. The results so far are good enough that NASA wants to increase the number of boxes available, in fact.

NASA's Launch Services Program, or LSP, has issued a Request for Proposal, or RFP, for new commercial Venture Class Launch Service, or VCLS, for small satellites, often called CubeSats or nanosatellites, and experiments on science missions using a class of rockets smaller than any currently available to the agency.

NASA plans to award one or more firm fixed-price VCLS contracts to accommodate 132 pounds of CubeSats in a single launch or

two launches carrying 66 pounds each. The launch provider will determine the launch location and date, but the launch must occur by April 15, 2018.

At present, launch opportunities for small satellites and science missions are primarily limited to ride-share type arrangements, flying only when space is available on NASA and other launches. LSP seeks to develop alternatives to this approach and help foster other launch services dedicated to transporting smaller payloads into orbit. The services acquired through such a contract will constitute the smallest class of launch services used by NASA.

This solicitation, and resulting contract or contracts, is intended to demonstrate

a dedicated launch capability for smaller payloads that NASA anticipates it will require on a recurring basis for future science and CubeSat missions.

The services acquired under the RFP mean NASA does not have to support a CubeSat launch vehicle on its own or pay for its development. The agency can buy the launch service as any other customer could and enjoy the savings since the rocket's costs are supported by a wide market of users. The boosters would be developed privately, and a single rocket would be able to send dozens of the tiny spacecraft into orbit at once on paths that best suit their scientific goals. Some of the tiny craft that contain experiments and sensors inside the area the size of a 4-inch

NASA's Launch Services Program has issued a draft Request for Proposal for a new Venture Class Launch Services, which would be commercial launch services for small satellites and experiments on science missions using a smaller than currently available class of rockets. Photo credit: NASA

cube may even be sent beyond Earth orbit to send back reports from deep space.

NASA's CubeSat Launch Initiative provides innovators at non-profits, educational institutions, and NASA sponsor missions with an accessible way to participate in space exploration. Universities, science clubs and organizations with an idea for a Kickstarter campaign can afford to build a small satellite and compete to get it flown

to research and development.

"This will start to open up viable commercial opportunities," said Mark Wiese, chief of the flight projects office for LSP.

"We hope to be one of the first customers for these companies, and once we get going, the regular launches will drive the costs down for everyone."

The emerging uses are for data valuable to a number of industries including farming,

Mars on a major spacecraft, for instance. On the other hand, if that sensor could be flown on a CubeSat and show its effectiveness, a future use becomes more practical more quickly.

"It proves the technology for our larger spacecraft," said Garrett Skrobot, Educational Launch of Nano-satellite, or ELaNa, mission manager. "If we find a sensor or a battery that works better, we



The full-scale mock-up of NASA's MarCO CubeSat held by Farah Alibay, a systems engineer for the technology demonstration, is dwarfed by the one-half-scale model of NASA's Mars Reconnaissance Orbiter behind her. Photo credit: NASA/JPL-Caltech

whereas traditional large satellites require a great deal more resources and involvement of many agencies and institutions to accomplish. For example, past CubeSats have been built with parts from smartphones, while others are a custom blend of materials and equipment. The next CubeSat launch opportunity through the CubeSat Launch Initiative will be released in early August.

CubeSats already are used in the commercial sector for purposes such as imagery collection and analysis, and are being used for operational purposes instead of being limited

shipping, data networking and the insurance field. The uses for the satellites, even as small as they are, require them to be in particular orbits in some cases, so piggybacking on the launch of another mission that may be heading to an orbit that is not as useful is no longer acceptable for the CubeSat market, Wiese said.

Dedicated rockets for small satellites also will benefit NASA's missions by pushing cutting-edge technology faster from the research level to usable stage. A sensor that works well in the lab, but has not been flown in space will find it difficult to get a trip to

can fly it on one of these and show whether it works. Then the team that uses it on something else does so with a lot more confidence."

The drive comes as CubeSat designers learn how to build observatories capable of studying distant black holes and cosmic X-ray background to track geomagnetic storms of Earth's weather patterns.

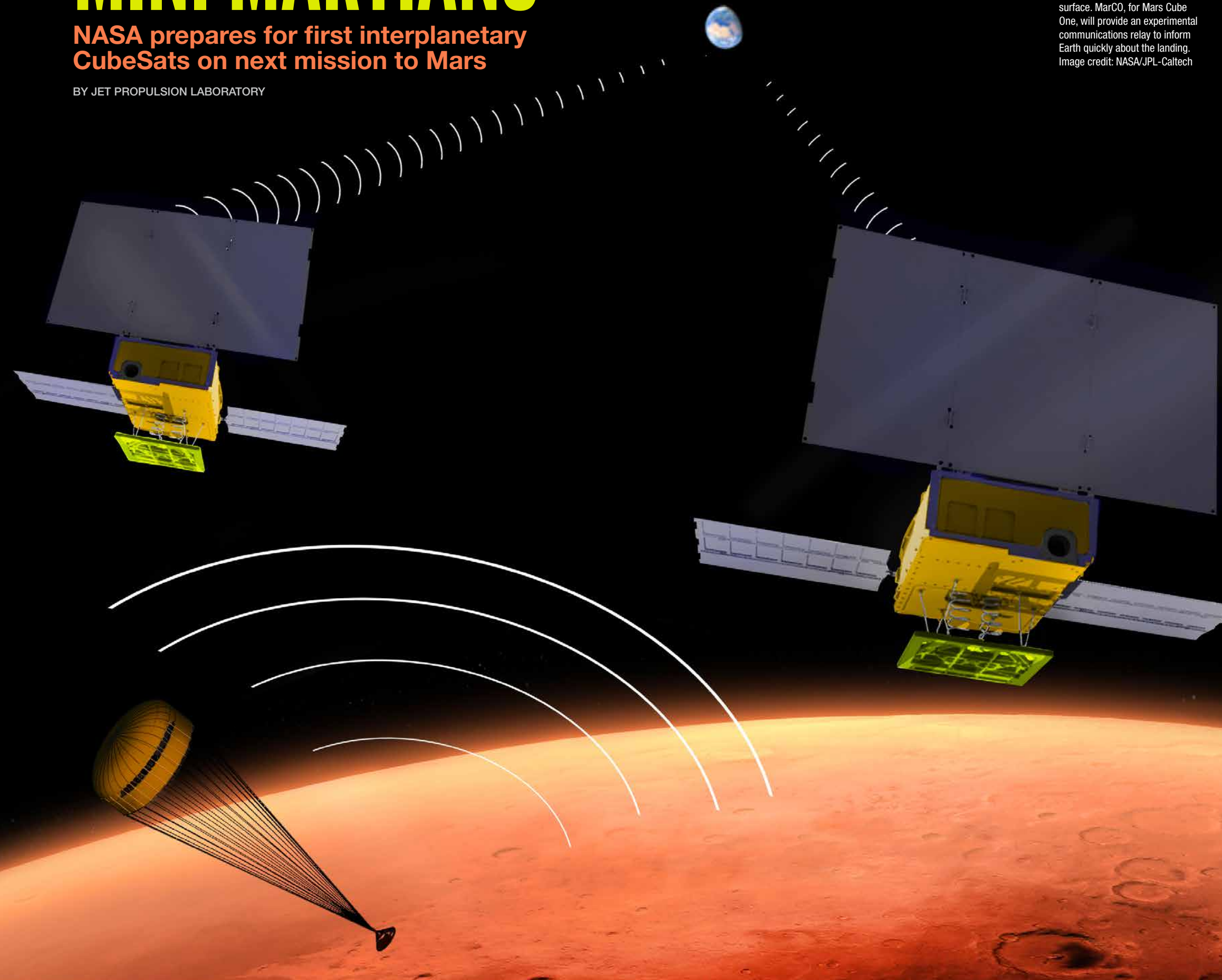
"As we drive costs down, that frees up more money for science," Wiese said. "We see this emerging capability to launch CubeSats as something the world is going to need."

# MINI MARTIANS

## NASA prepares for first interplanetary CubeSats on next mission to Mars

BY JET PROPULSION LABORATORY

NASA's two small MarCO CubeSats will be flying past Mars in 2016 just as NASA's next Mars lander, InSight, is descending through the Martian atmosphere and landing on the surface. MarCO, for Mars Cube One, will provide an experimental communications relay to inform Earth quickly about the landing. Image credit: NASA/JPL-Caltech



When NASA launches its next mission on the journey to Mars — a stationary lander in 2016 — the flight will include two CubeSats. This will be the first time CubeSats have flown in deep space. If this flyby demonstration is successful, the technology will provide NASA the ability to quickly transmit status information about the main spacecraft after it lands on Mars.

The twin communications-relay CubeSats, being built by NASA's Jet Propulsion Laboratory, or JPL, constitute a technology demonstration called Mars Cube One, or MarCO. CubeSats are a class of spacecraft based on a standardized small size and modular use of off-the-shelf technologies. Many have been made by university students, and dozens have been launched into Earth orbit using extra payload mass available on launches of larger spacecraft.

The basic CubeSat unit is a box roughly 4 inches square. Larger CubeSats are multiples of that unit. MarCO's design is a six-unit CubeSat — about the size of a briefcase — with a stowed size of about 14.4 inches by 9.5 inches by 4.6 inches.

MarCO will launch in March 2016 from Vandenberg Air Force Base, California on the same United Launch Alliance Atlas V rocket as NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, or InSight, lander. InSight is NASA's first mission to understand the interior structure of the Red Planet. MarCO will fly by Mars while InSight is landing, in September 2016.

"MarCO is an experimental capability that has been added to the InSight mission, but is not needed for mission success," said Jim Green, director of NASA's planetary science division at the agency's headquarters in Washington. "MarCO will fly

independently to Mars."

During InSight's entry, descent and landing, or EDL, operations on Sept. 28, 2016, the lander will transmit information in the UHF radio band to NASA's Mars Reconnaissance Orbiter, or MRO, flying overhead. MRO will forward EDL information to Earth using a radio frequency in the X band, but cannot simultaneously receive information over one band while transmitting on another. Confirmation of a successful landing could be received by the orbiter more than an hour before it's relayed to Earth.

MarCO's radio is about softball-size and provides both UHF (receive only) and X-band (receive and transmit) functions capable of immediately relaying information received over UHF.

The two CubeSats will separate from the Atlas V booster after launch and travel along their own trajectories to the Red Planet. After release from the launch vehicle, MarCO's first challenges are to deploy two radio antennas and two solar panels. The high-gain, X-band antenna is a flat panel engineered to direct radio waves the way a parabolic dish antenna does. MarCO will be navigated to Mars independently of the InSight spacecraft, with its own course adjustments on the way.

Ultimately, if the MarCO demonstration mission succeeds, it could allow for a "bring-your-own" communications relay option for use by future Mars missions in the critical few minutes between Martian atmospheric entry and touchdown.

By verifying CubeSats are a viable technology for interplanetary missions, and feasible on a short development timeline, this technology demonstration could lead to many other applications to explore and study our solar system.

# Project Runway

## NASA signs agreement with Space Florida to operate historic landing facility

BY STEVEN SICELOFF

One of the longest runways in the world is about to get a new operator after NASA and Space Florida concluded the final elements of a deal that will allow the Shuttle Landing Facility, or SLF, to expand as a base for commercial aerospace work in addition to the regular load Kennedy Space Center puts on it.

“The SLF is a unique construction in the state and in the world and we want to make sure it remains a benefit to the American taxpayer while also using it as a catalyst for the private market,” said Bob Cabana, Kennedy’s center director and a shuttle commander and pilot who landed the 110-ton glider on the same runway twice. “The thing that is most different about our runway here is that it is proven in its ability to handle a space plane that has returned through the atmosphere and is approaching with one chance to land safely. It sounds like a simple thing, but making that simple thing effective and efficient takes extraordinary work and diligent care.”

With the final landing of the shuttle program in 2011, the runway and the team overseeing it has adapted to a new set of vehicles. Gigantic cargo planes still pull up to the ramp several times a year to deliver everything from

bulky payloads such as the Orion heat shield to completed rocket stages including the Atlas V booster stage and Centaur upper stages. The site also has made a name for itself in automotive circles as an aerodynamics laboratory where companies can try out designs safely and push the envelope to more efficient car operations.

Its appeal is the vast stretch of almost-flat concrete that is available year-round. Similar areas of the world used as proving grounds either have surfaces that are a bit unpredictable or lie in climates that make them unusable for months at a time because of weather.

Private companies frequently request time on the Shuttle Landing Facility for a variety of reasons and that demand is expected to increase in the future as companies that were

commercial startups evolve to mature enterprises. The new arrangement with Space Florida is expected to maximize the opportunities to utilize the runway creatively while maintaining its ability to serve NASA and the center during the ongoing transformation to a multi-use spaceport.

“This marks the dawn of a new era for horizontal spaceflight in Florida and the country as a whole,” said Space Florida’s President and CEO Frank DiBello.

“The most storied runway in the world will now become the cornerstone of Florida’s next generation commercial spaceport.”

The SLF will be an enabler for the next generation of spaceflight companies and provide unique testing and support capabilities that allow growth in several upcoming markets. The customer base for Space Florida’s operations will

focus on three main markets just-in-time delivery systems, Unmanned Aerial Vehicles, or UAV, and next generation space launch systems.

“The SLF kind of embodies what we want to do across the center to make the best use out of all the structures and abilities we have,” said Scott Collredo, director of Kennedy’s Center Planning and Development. “NASA needs this runway, but it doesn’t need it every day of the year. No one else needs it 365 days a year either, but we can schedule the uses of it so all of us together — NASA and the private companies — can use it when we need it.”

Within the past couple of years, an artificial landscape was built past the north end of the runway where experimental flying machines such as NASA’s Morpheus and the Moon Express spacecraft can work out the details of making automated landings

on distant worlds such as Mars. Because of the vastness of the SLF, testing can take place on the north end landing area without halting all work on the rest of the runway, particularly the ramp at the south end.

Though a single concrete strip, the SLF is managed as a two-runway field depending on the direction the aircraft or shuttle is approaching: runway 15 going southeast to northwest and runway 33 for the opposite.

The runway gained in notoriety through the Space Shuttle Era as more and more missions wrapped up with a shuttle touching down on the runway and being wheeled off a couple miles to the Orbiter Processing Facility to begin preparations for its next mission.

“The history of the SLF shines, and this development makes its future, just like that of Kennedy, shine just as brightly,” Cabana said.

Since the retirement of the Space Shuttle Program, the runway remains in use by transport aircraft, T-38s and astronauts, as well as specialized aerodynamic research projects. Photo credit: NASA

# THE GREATEST AMERICAN HEROES

## New exhibit will inspire next generation of space explorers

BY LINDA HERRIDGE

What are the qualities that make a hero? Visitors to the Kennedy Space Center Visitor Complex soon will get to experience the pioneers of space exploration, from the early days of the Mercury Program, to the Gemini and early Apollo missions. As the U.S. Astronaut Hall of Fame celebrates its 25th anniversary this year, NASA and the visitor complex, managed by Delaware North, broke ground May 29 on a next generation attraction, Heroes and Legends featuring the Astronaut Hall of Fame.

“Heroes and Legends will tell the stories of American space explorers in a more engaging, more compelling and more

imaginative way than ever before,” said Kennedy Space Center Director Bob Cabana.

“We not only celebrate NASA’s rich history but also look toward the future of space exploration,” said NASA Administrator Charlie Bolden. “This attraction promises to bridge the gap between the trailblazers of the past and those who will write the next chapter of space travel.”

Jim Hauser, president of Delaware North’s parks and resorts business said, “We look forward to celebrating many more anniversaries at the visitor complex.”

Are you dedicated? Curious? Courageous? Can you be cool under pressure? Wind

around the Rocket Garden in an enclosed walkway featuring an interactive ramp and views of the rockets and find out as you enter the heroes’ journey.

According to Eric Stiles, a NASA design specialist at the visitor complex, Heroes and Legends will transport guests back to the early years of NASA’s space program using four unique settings.

“It’s going to be a different kind of exhibit,” Stiles said. “We want it to be an inspirational experience for guests at the visitor complex.”

Therrin Protze, chief operating officer for the visitor complex, said Heroes and Legends



An artist's rendering of what the Heroes and Legends exhibit at the Kennedy Space Center Visitor Complex will look like after it's opening in 2016. Image credit: NASA

will be the first stop for guests as they enter the visitor complex, setting the tone for their entire experience.

“They will leave Heroes and Legends subtly transformed, their outlook expanded, their perspective deepened, and their appreciation for NASA’s core mission significantly enhanced,” Protze said.

In Discovery Bay, view a 7-minute presentation about human spaceflight and NASA’s brave astronauts. Hear in the astronaut’s own words who their heroes are. View an inspiring tribute to the astronauts who made the ultimate sacrifice in pursuit of their dreams.

Are you ready to find the hero in you? Are you ready for your heroic journey? Enter the Heroes and Legends main theater as the doors open and darkness envelops you. Step onto a dimly lit suspended platform, don your 3-D glasses and experience a 360-degree view of Earth and space, above you, below you, all around you. Hear and see the spellbinding experiences of four astronauts: Alan Shepard, John Glenn, Jim Lovell and Neil Armstrong. Their stories also will acknowledge the invaluable efforts of numerous “earthbound heroes,” the engineers, technicians, mission controllers, administrators and others who helped the astronauts achieve their missions.

An interactive exhibit zone will greet visitors next. Guests will be able to explore 10 multimedia and interactive story zones and view artifacts and exhibits, including a full-size Mercury Redstone rocket, a replica of Mercury mission control with actual controls and displays, and the real Sigma 7 capsule that carried astronaut Wally Schirra into orbit around the Earth on Oct. 3, 1962.

**“This attraction promises to bridge the gap between the trailblazers of the past and those who will write the next chapter of space travel.”**

NASA Administrator Charlie Bolden

The final exhibit is the U.S. Astronaut Hall of Fame. A large 360-degree cylinder will be the origination point for high-definition projections of still and moving images in the center of the room. Guests can take photos with larger-than-life images of their astronaut heroes. A montage will include all of the Mercury, Gemini, Apollo and space shuttle astronauts inducted into the Astronaut Hall of Fame.

“We’re starting on a new journey in the Astronaut Hall of Fame,” said Dan Brandenstein, former astronaut and chairman of the Astronaut Scholarship Foundation.

Former astronaut and recent U.S. Astronaut Hall of Fame inductee Steven Lindsey said Heroes and Legends really will be about the next generation of space explorers.

“If we can do something to inspire the next generation, they can see through us that it takes hard work and dedication,” Lindsey said.

Cecil Magpuri, president and chief creative officer of Falcon’s Tree House, the designer of the exhibit, said that by the time guests exit this attraction, they will have developed a whole new understanding and appreciation for NASA’s astronaut heroes.

“I’m so excited about this project. I look forward to coming back here and experiencing this important and amazing attraction,” Magpuri said.

Scheduled to open in 2016, Heroes and Legends featuring the U.S. Astronaut Hall of Fame will replace the attraction currently known as Early Space Exploration.



The Heroes and Legends exhibit will bring to life the stories of America’s pioneering astronauts and invite guests to vicariously experience the thrills and dangers of America’s earliest missions as shown in the artist’s rendering. Image credit: NASA

# PASSION ABOUNDS

## New deputy administrator visits Kennedy



NASA Deputy Administrator Dava Newman addresses Kennedy Space Center employees during an All-Hands as Center Director Bob Cabana looks on June 25. Photo credit: NASA/ Cory Huston

administrator,” Cabana said. “She’s a real fan of technology and innovation, and that’s one of the key areas that we want to do better at here at KSC. She’s also going to be looking after education for NASA, amongst other things. I think being a professor at MIT, nobody knows education better than that.”

Newman joined NASA in May. Prior to her tenure with NASA, Newman was the Apollo Program Professor of Astronautics at MIT. Her expertise is in multidisciplinary research that encompasses aerospace biomedical engineering.

Newman’s research studies were carried out through spaceflight experiments, ground-based simulations, and mathematical modeling. Her

NASA’s new deputy administrator, Dr. Dava Newman, visited Kennedy Space Center on June 25-26. While here, Newman went behind the scenes to see how a multi-user spaceport operates — she even viewed the center from an aerial perspective with Center Director Bob Cabana at the controls.

Not only did the deputy administrator speak with workers one-on-one during her extensive tour, she also met with hundreds of employees and interns during an all-hands June 25. To a packed auditorium, Newman spoke about her background as a Massachusetts Institute of Technology (MIT) professor and her passions related to space exploration.

“We were meant to explore, and we are explorers,” Newman said during the briefing.

Employees couldn’t get enough of the spirited newcomer as they asked her questions about the space suit she had been working on at MIT and even how she inspires other women to pursue STEM careers.

“I’m thrilled to be here! Jules Vern — one of my heroes — once wrote, ‘Anything one person can imagine, other people can make real.’ That’s what you’re all doing every day here at Kennedy Space Center. You’re taking imagination and making it reality.”

“We are blessed to have Dr. Dava Newman as our deputy

latest research efforts included: advanced space suit design, dynamics and control of astronaut motion, mission analysis, and engineering systems design and policy analysis. She also had ongoing efforts in assistive technologies to augment human locomotion here on Earth.



NASA Deputy Administrator Dava Newman boards a helicopter at Kennedy Space Center on June 26 during her first tour of Kennedy since taking office in May. Photo credit: NASA/Sandra Joseph

While at Kennedy, Newman took the time to sit down with the magazine to give us a bit more insight into her, as a person, not just as the No. 2 for NASA. Here’s what she had to say:

**Q: Before joining NASA, what was your proudest achievement?**

A: Sailing around the world in our sail boat — just circumnavigating — with my partner, Guillermo. That was our exploration of the earth, and we taught kids all over the world. So that was a great personal achievement. *Newman had her own “Apollo 13” moment when the boat had a hydraulic fluid leak, and she had to fix it with tubing and olive oil she had onboard.*

At MIT as a professor in aeronautics and astronautics, I’m called a MacVicar Faculty Fellow, so that chaired position is for making substantial impact in undergraduate education. That’s probably one of my proudest honors and awards — just to really impact undergraduate teaching.

**Q: What facets of your diverse background will you be bringing to the agency?**

A: I’m passionate about exploration. As an aerospace engineer, I also specialize in human performance — that is really aerospace-biomedical engineering. I’m really thrilled to bring that to the agency and onward to our journey to Mars. Looking for exploration of a future beyond space station, beyond low-Earth orbit, into the proving grounds, and then finally proving that at Mars.

**Q: What’s the biggest challenge you have overcome since joining NASA a little over a month ago?**

A: The biggest challenge so far is all the multi-tasking! It’s keeping me busy, but it’s great because I’m in receive mode, getting up to speed on all missions and all mission directorates, and all of NASA’s portfolio from science to human exploration to aeronautics... and technology development. What a great way to spend your day — just getting information overload on the whole portfolio of NASA.

**Q: What do you like most about NASA’s current path forward?**

A: It’s all about exploring. That’s the excitement to me. In our journey to Mars we are looking to go beyond low-Earth orbit into cis-lunar space and to Mars. And I always like to point out, for NASA space science work, we’re already at Mars. We have five vehicles either roving or orbiting Mars right now so we are learning so much every day.

**Q: How do you hope to impact NASA’s future exploration endeavors?**

A: I’m going to concentrate on NASA’s journey to Mars and exploration, specifically looking at technology and innovation as well as education. Those are the areas I’m really passionate about and that I get to hopefully impact.

**Q: Where do you see yourself in 10 years?**

“I’m really concentrating on the next few years and what I can do at NASA in terms of leadership and furthering our vision — getting us to Mars. Always continuing in terms of space exploration.

**Q: What would you say to young girls who aspire to be like you?**

A: I say to every young girl and boy, and everyone out there who will listen, to do what they love. I tell them what engineers get to do because I think I have the best job in the world — we get to design and build and create things — and create things that might take us to future planets — and investigate Earth which is really important — I find a lot of kids really want to know what is going on here on Earth. We get to look at Earth, but we get to look out, as well, into the stars. Any young person who is excited about dreaming and exploration, and imagination . . . tell them, you know what? Engineers get to do a lot of that — we build and design all those systems — and then we get to fly them sometimes. So that’s my message, and I love it. And my enthusiasm hopefully just rubs off. I’m lucky to have this job, but the possibilities are open for any young person.

**Q: What is the one thing nobody knows about you, but you wish they did?**

A: Most people do know I’m a sailor. Most people don’t know I’m not a very good cook, but I love food! Some people don’t know I was a former basketball player. I’m sitting down, but I’m pretty short.

**Q: What surprises you about what you’ve seen since you started at NASA?**

A: I’m pleasantly surprised about all the accomplishments every single day. Every day I get to celebrate some new science, testing of a rocket engine, something like that. It’s even more than I ever thought, so that’s my most pleasant surprise. It’s just all the good news, every day in terms of the accomplishments of all the great NASA work.



# IN MEMORIAM



JACK KING  
1931-2015



In the Firing Room of Kennedy Space Center's Launch Control Center, Jack King's announcements keep the public up-to-date during the countdown for Apollo 12, the second lunar landing mission launched Nov. 14, 1969. With one exception (Apollo 13), King provided launch countdown commentary for every American human spaceflight from Gemini 4 in 1965 through Apollo 15 in 1971. Photo credit: NASA

## NASA mourns loss of former launch commentator, Jack King

BY BOB GRANATH

**J**ohn W. (Jack) King, former chief of Public Information at Kennedy Space Center, died June 11, 2015. He was 84. A resident of Cocoa Beach, Florida, King worked in the space agency's Public Affairs office from 1960 until 1975. He returned to Kennedy in 1997, working for space shuttle contractor United Space Alliance, or USA, until his 2010 retirement.

King is remembered by many, including Kennedy's Director, Bob Cabana.

"Jack King counted down the launch of Apollo 11 and all of us watching on television will never forget his calm, reassuring demeanor," said Cabana, a former space shuttle astronaut. "Jack was a true professional and helped us understand in common English the complexities of space flight. He was great at communicating what we do at NASA and he will be missed."

According to Hugh Harris, retired

director of NASA Public Affairs at Kennedy, King was instrumental in instituting open communications with the public during the beginning of America's civilian space program.

"Jack helped establish the original systems to ensure the news media received timely and accurate information about both the early human flight programs and the unmanned missions," Harris said.

Born in the Brighton section of Boston, Massachusetts on Feb. 12, 1931, King was the son of the sports editor for the Associated Press. In 1953 he earned a bachelor's degree in English from Boston College.

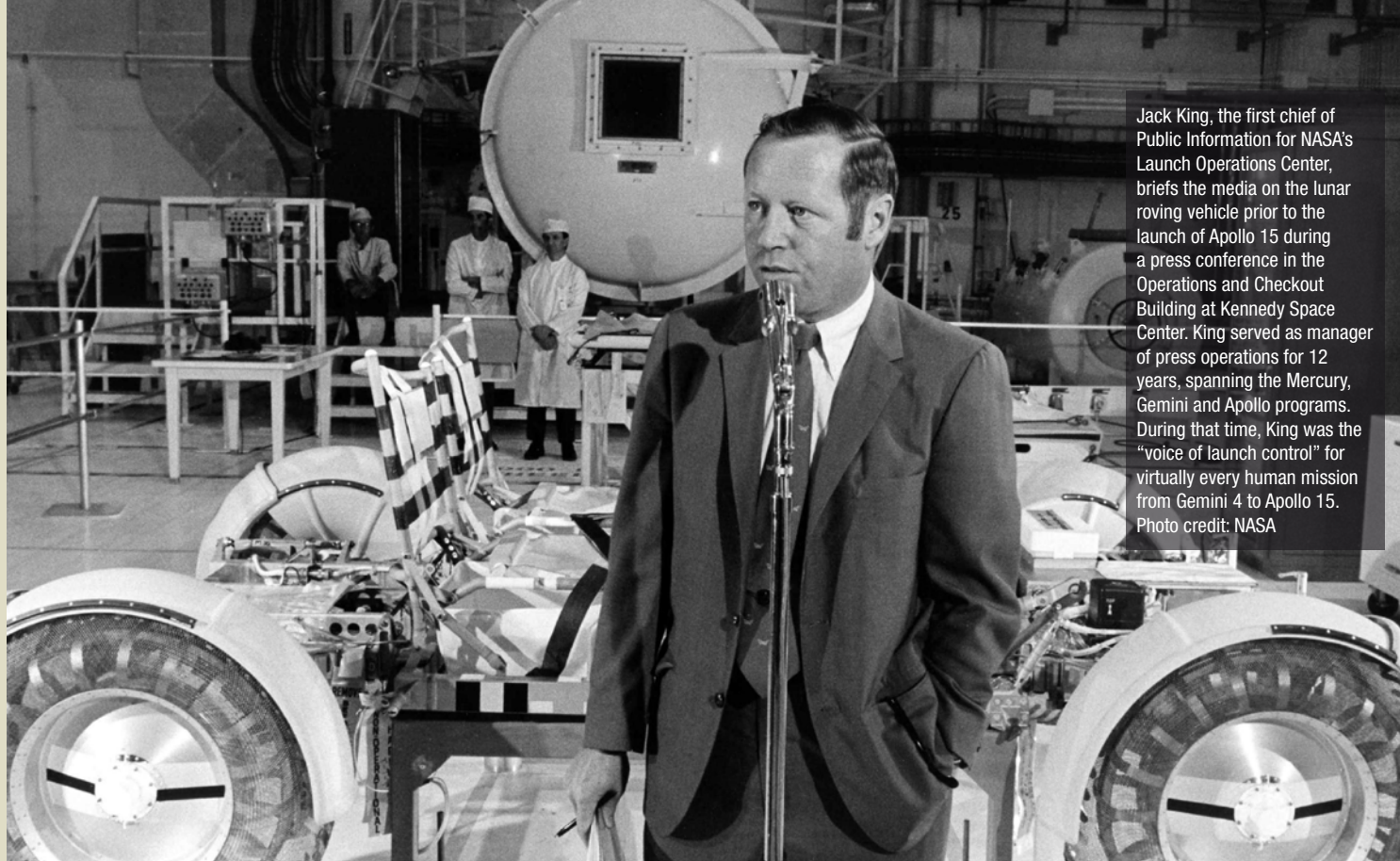
King was commissioned as a second lieutenant in the United States Army artillery corps immediately after graduation and served two years in Korea and Japan from 1953 through 1955.

After his military service, King followed

in his father's footsteps as a news reporter in the Associated Press Boston Bureau. Shortly after the United States launched its first satellite, Explorer 1, in 1958, King was assigned to cover the fledgling space program from Cocoa Beach.

In 1960, Kurt Debus, Kennedy Space Center's first director, hired King to serve as NASA's chief of Public Information based on his experience as the space reporter and bureau chief for the Associated Press Cape Canaveral Bureau from 1958 to 1959. Many of the launches were classified military rockets and a new mindset was required at the growing launch center.

"The biggest PR job I had to do was with our own people in order to get information that I could pass out to the news media," King said during an interview for an oral history project in June 2002. "These were the early days when things were just starting out."



Jack King, the first chief of Public Information for NASA's Launch Operations Center, briefs the media on the lunar roving vehicle prior to the launch of Apollo 15 during a press conference in the Operations and Checkout Building at Kennedy Space Center. King served as manager of press operations for 12 years, spanning the Mercury, Gemini and Apollo programs. During that time, King was the "voice of launch control" for virtually every human mission from Gemini 4 to Apollo 15. Photo credit: NASA

During that time, the attention of the world and many of America's leaders focused on Cape Canaveral. Three weeks after Alan Shepard became the first American in space on May 5, 1961, President John F. Kennedy raised the sights of the space program even further.

"Right after the Shepard launch is when Kennedy said, let's go to the moon," King said. "After (John) Glenn was launched ... Kennedy was at (Cape Canaveral) welcoming him back."

King served as manager of press operations for 12 years, spanning the Mercury, Gemini and Apollo programs.

During that time, King was the "voice of launch control" for virtually every human mission from Gemini 4 to Apollo 15. He described countdown events as millions around the world watched the liftoff of the Saturn V rocket that carried the Apollo 11 astronauts to the moon.

In 1972 King became director of Public Affairs for NASA's Johnson Space Center in Houston. There he had wider responsibilities for directing programs that included education outreach, exhibits and astronaut appearances, as well as intergovernmental and community relations.

After the United States and Soviet Union agreed to a mission in which an Apollo spacecraft would link up with a Soyuz in July 1975, King joined a three-member team that negotiated the joint information plan for the Apollo-Soyuz Test Project, or ASTP. The resulting agreement included the first live television coverage of a Russian rocket launch and Soyuz landing at the end of the Russian portion of the flight.

After ASTP, King moved to Washington, D.C., accepting a position as director of Public Affairs for the Department of Energy Research and Development to build an agency wide publicity program in solar, fossil and nuclear energy.

King left government service in 1977 to work for Dr. Armand Hammer, chairman of Occidental International Corp. for whom he developed and implemented a wide-ranging public relations program. He also served as the chairman's speech writer and coordinator of media events in connection with his numerous travels and philanthropic activities.

After Hammer's death in December 1990, King served as vice president of Powell Tate, a leading communications and public affairs firm in Washington, specializing in defense, space technology and energy issues.

King returned to Florida's Space Coast in 1997, assuming responsibilities for news media relations for USA, NASA's prime contractor for day-to-day Space Shuttle Program operations.

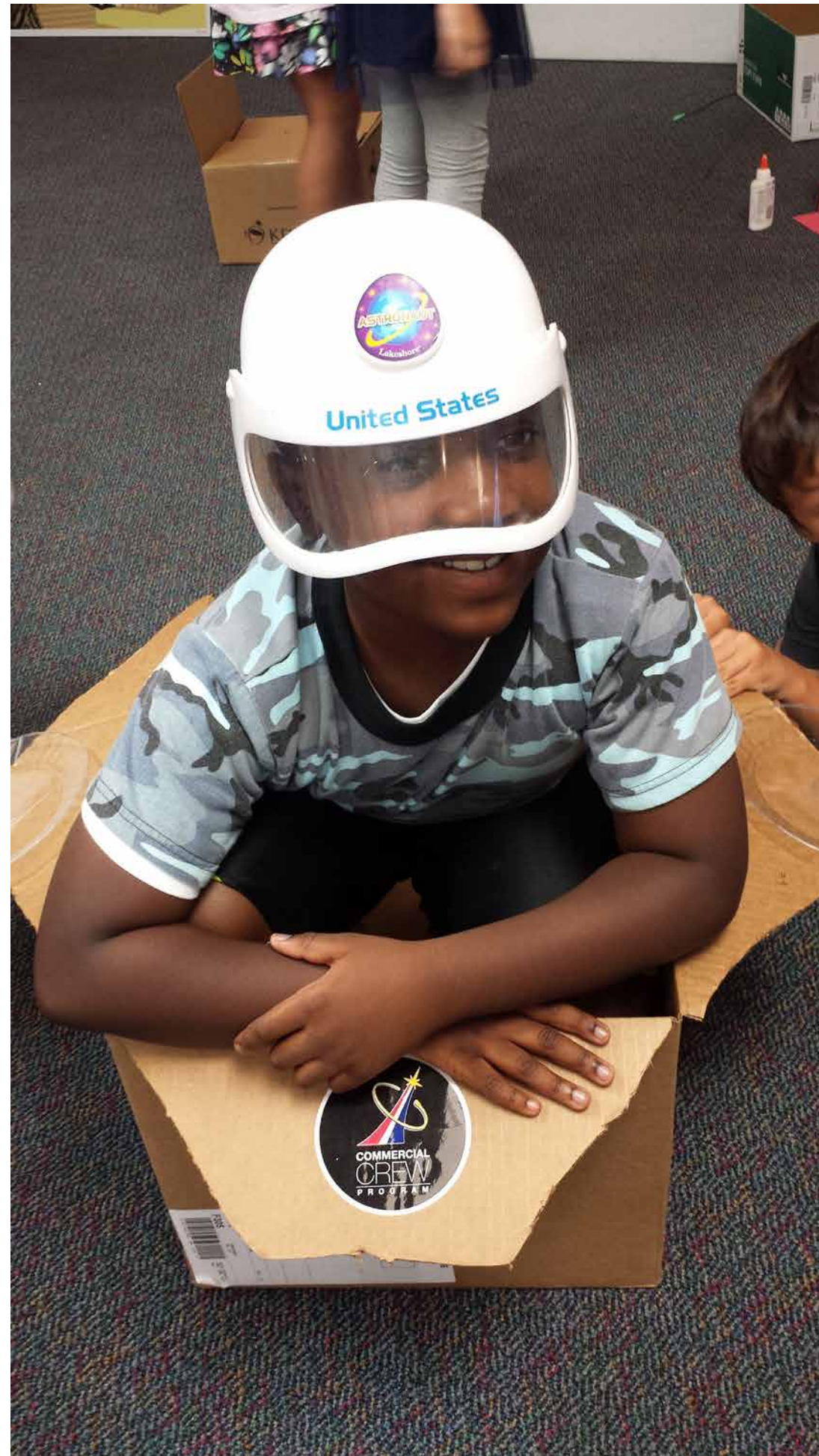
King was posthumously awarded the NASA Distinguished Service Medal, the highest award bestowed by the agency. It is awarded to those who personally made a contribution so extraordinary that other forms of recognition would be inadequate.

King was a two-time recipient of the NASA Exceptional Service Medal and winner of the Aviation/Space Writer's Lawrence Award as the outstanding U.S. government public information officer in 1969. In 2000 he was one of the first two recipients of the Harry Kolcum Memorial News and Communications Award presented by the National Space Club Florida Committee, recognizing the highest standards in journalism and public affairs work.

King retired from USA in October 2010, but continued to serve as a NASA public affairs volunteer.

A widower, King and his wife Evelyn were married 39 years prior to her death in 2005. They had three children and five grandchildren.

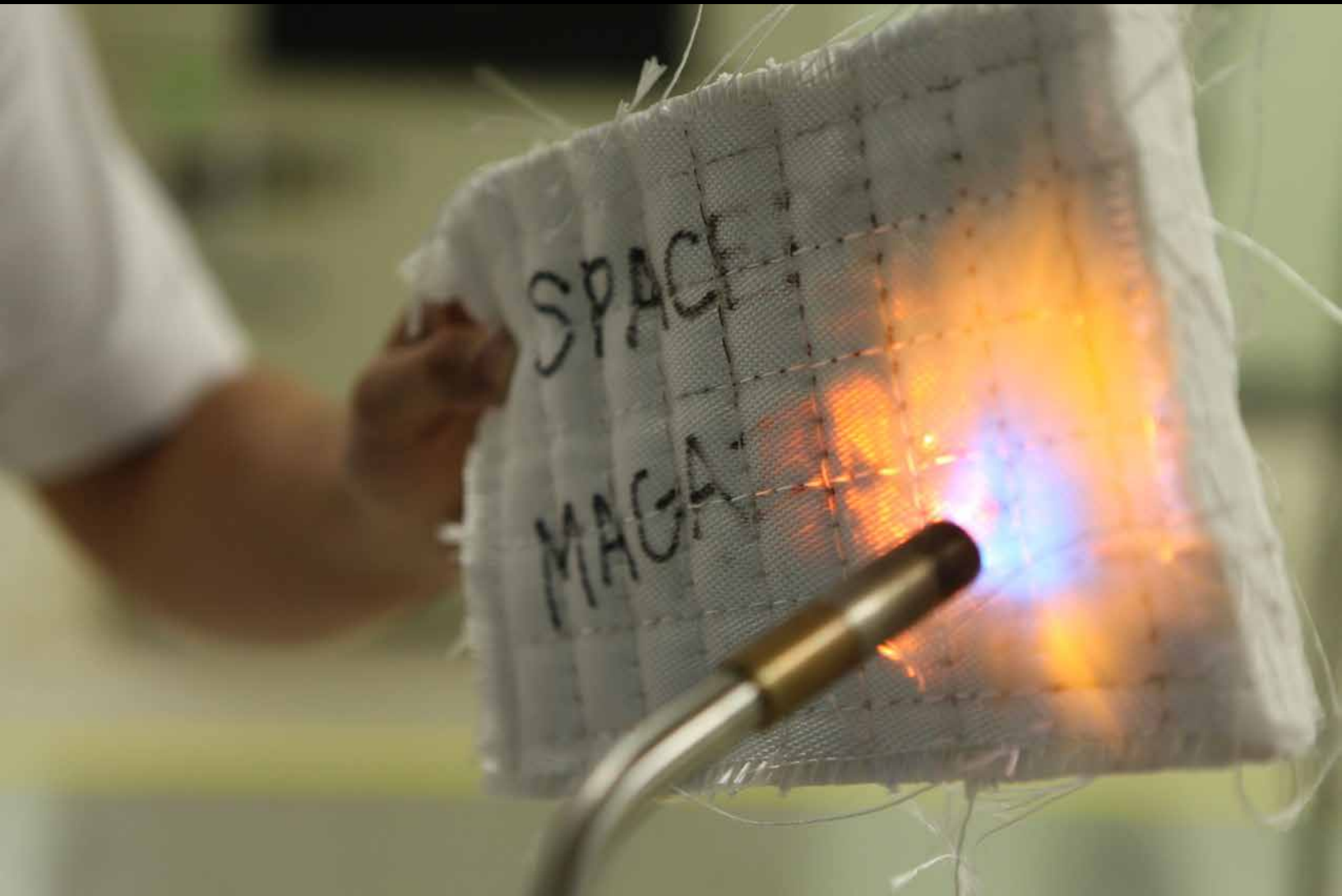
## KSC Scenes



"Sometimes when you are an engineer, you have to get it wrong, before you can get it right," said Rebecca Regan, an employee at NASA's Kennedy Space Center.

On June 8, Regan taught 17 elementary school students at Kennedy's Child Development Center about the Commercial Crew Program and the need to have American-made spacecraft and rocket systems carry people to and from space. After the lesson, each student built their own spacecraft out of cardboard boxes and art supplies.

Photo credit: NASA



A technician with Jacobs Technology shows media and social media representatives how space shuttle blankets fared as organics, like permanent marker, were burned off during a demonstration prior to the SpaceX CRS-7 launch. Photo credit: NASA

National Aeronautics and Space Administration

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