

# Spaceport News

John F. Kennedy Space Center - America's gateway to the universe



## Triumphs, milestones highlight 2013

By Linda Herridge  
Spaceport News

Kennedy Space Center accomplished many milestones in 2013 as it continued to transition from a historically government-only launch facility to an affordable, sustainable, multiuser spaceport for both government and commercial customers.

"It's been an exciting and productive year here at Kennedy," said Director Bob Cabana. "We have made tremendous progress in 2013. As challenging and exciting as this year has been, next year will be even more so as we continue to implement the plan we've charted for our future."

### Launch Services Program

The Launch Services Program (LSP), managed at Kennedy, began 2013 with the successful launch of NASA's TDRS-K satellite Jan. 30 aboard a United Launch Alliance (ULA) Atlas V rocket from Cape Canaveral Air Force Station (CCAFS) in Florida.

LSP followed up with another launch, less than a month later, when NASA's Landsat Data Continuity Mission roared into space Feb. 11 aboard a ULA Atlas V rocket from Vandenberg Air Force Base in California.

A second LSP launch from the west coast occurred on June 27, when NASA's Interface Region Imaging Spectrograph spacecraft was placed in orbit by a Pegasus XL rocket.

On Nov. 18, a ULA Atlas V lifted off from CCAFS and sent the Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft on its way to study the Red Planet's upper atmosphere.

Scientists expect data gathered during the MAVEN mission will help explain how Mars' climate has changed due to the loss of atmospheric gases.

MAVEN will enter a Mars orbit in Sep-



NASA/Kim Shifflett

An aerial view shows construction progress at Launch Pad 39B at Kennedy Space Center on May 6, 2013.

tember 2014 to begin its one-year research mission.

The program also successfully launched 16 CubeSats as secondary payloads on rocket launches.

### Ground Systems Development and Operations Program

The Ground Systems Development and Operations (GSDO) Program continued to upgrade or modify several facilities and

ground support equipment to be ready to support the processing and launch of NASA's Exploration Flight Test-1 in 2014 and the agency's Space Launch System (SLS) and Orion spacecraft in 2017.

At Launch Pad 39B, construction crews have removed the space shuttle-era flame deflector and Apollo-era brick walls from the flame trench that sits below and between the crawler tracks to make way for a new

# Rovers Spirit, Opportunity celebrate 10th anniversary on Red Planet

By Bob Granath  
Spaceport News

Androids rolling along distant planets once were only the stuff of science fiction. However, in recent years, mechanized trailblazers have become NASA's precursors to human explorers. Among the most successful have been the twin Mars Exploration Rovers (MERs), known as Spirit and Opportunity, now marking a full decade of work on the Red Planet.

The Mars Exploration Rovers' objectives were to search for and characterize a wide range of rocks and soils that hold clues to past water activity on Mars. Mission planners initially hoped the two rovers would operate for 90 Martian days, or sols. The term sol refers to the duration of a solar day on Mars, equal to 24 hours and 39 minutes on Earth.

What followed went far beyond expectations. After 90 sols, both MER-A (Spirit) and MER-B (Opportunity) still had plenty of life, and multiple mission extensions kept Spirit functioning until March 22, 2010. Opportunity continues to operate, having traveled more than 24 miles across the Martian surface.

"The two rovers are a testament to NASA ingenuity and the confidence and investment the American people have placed in their space program," said NASA Administrator Charlie Bolden remarking on the rovers' longevity. "Together, these amazing robots will go down in history for their tenacity and their many findings."

Preflight processing for MERs A and B started in early 2003 as the hardware began arriving at Kennedy Space Center. Preparations included testing of the 410-pound spacecraft inside the spaceport's Payload Hazardous Servicing Facility. The rover systems were given thorough checkouts for mobility and maneuverability. During this time, engineers and scientists at Kennedy worked closely with counterparts from Jet Propulsion Laboratory (JPL), a division of the California Institute of Technology in Pasadena, Calif., where the Mars Exploration Rover project was developed.

During April and May 2003, Delta II Heavy launch vehicles were stacked at Cape Canaveral Air Force Station's Launch Complex Pads 17-A and 17-B. Spirit

launched on June 10, 2003, and Opportunity followed on July 7, 2003.

Sheryl Bergstrom, manager of the JPL's resident office at Kennedy, had high praise for the Kennedy launch team.

"Members of the spacecraft team are to be credited for their efforts," she said.

Albert Sierra, of Kennedy's Launch Services Program (LSP) Mission Management office, also complimented the joint effort.

"The team worked closely together nearly three years on the integration and launch activities for both missions," he said.

Following their seven-month trip to Mars, the rovers landed in widely separated equatorial locations on the Red Planet. Spirit successfully touched down on Jan. 3, 2004, at Gusev Crater, a Connecticut-size basin that appeared to once have held a lake. For Opportunity, NASA chose a location halfway around the planet from its counterpart. The second rover arrived three weeks later,

on Jan. 24, in a broad plain named Meridiani Planum. The second site's selection was based on a different type of evidence for a possible watery past. Since experts consider water to be a requirement for living organisms, areas that once contained water are considered likely locations for evidence of past life forms.

"The instrumentation onboard these rovers, combined with their great mobility, will offer a totally new view of Mars, including a microscopic view inside rocks for the first time," said Dr. Ed Weiler, then NASA's associate administrator for Space Science.

Omar Baez, who was Kennedy's Mars Missions launch director, now LSP launch director, put the landings in perspective.

"The hard geological science of reaching out and touching, drilling and analyzing the Martian surface is another stepping stone in exploring the universe," he said.

It didn't take long to make the first important

discovery, with Opportunity hitting the jackpot early. It landed close to a thin outcrop of rocks. Within two months, its versatile science instruments found evidence in those rocks that a body of salty water deep enough to splash in once flowed gently over the area. Preliminary interpretations point to a past environment that could have been hospitable to life and also could have preserved fossil evidence of it.

Scientists evaluating data from Spirit later identified a water-signature mineral called goethite in bedrock, one of the mission's surest indicators yet for a wet history on Spirit's side of Mars. Goethite forms only in the presence of water, whether in liquid, ice or gaseous form.

"Goethite, like the jarosite that Opportunity found on the other side of Mars, is strong evidence for water activity," said Dr. Goestar Klingelhofer of the Univer-

sity of Mainz, Germany, lead scientist for the iron-mineral analyzer on each rover, the Moessbauer spectrometer.

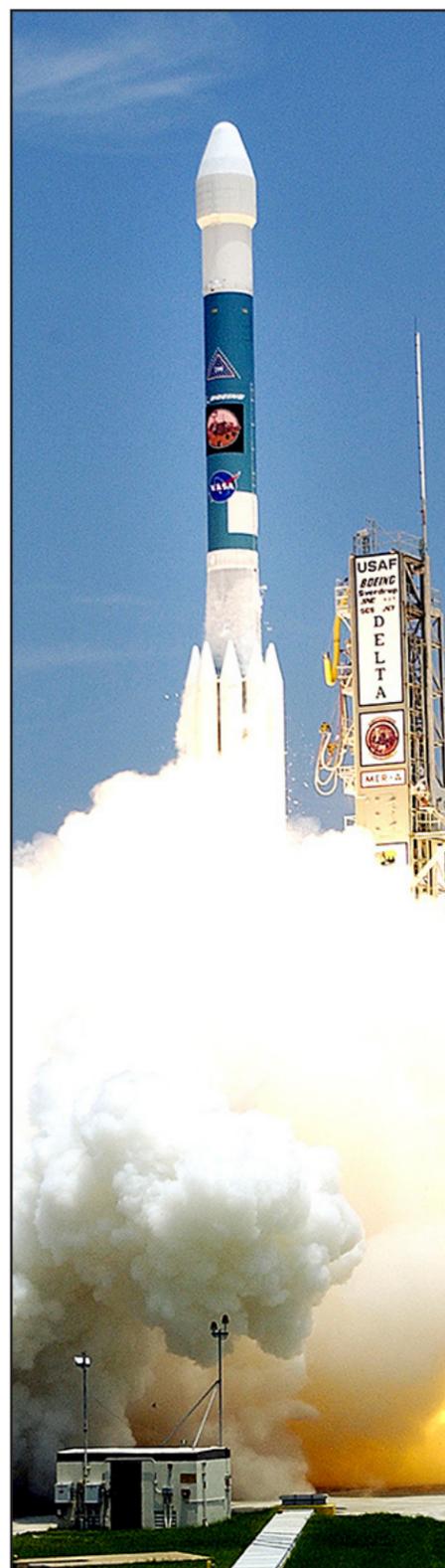
In April 2004, the two mobile robots successfully completed their primary 90-sol missions on opposite sides of Mars and went into bonus overtime work. Spirit went on to function effectively over 20 times longer than NASA planners expected. After becoming stuck in the soft Martian soil, the rover continued in a stationary science platform role until communication with it stopped on March 22, 2010. Spirit logged 4.8 miles of driving instead of the planned 0.4 mile, allowing more extensive geological analysis of Martian rocks and planetary surface features.

As of Jan. 1, 2014, JPL's Mars Exploration Rovers website reported that Opportunity had traveled slightly more than 24 miles, surpassing the longest distance driven by a vehicle on another world. The record was previously held by Russia's Lunokhod 2 rover that drove 23 miles on the moon in 1973.

The Opportunity rover continues to operate and is currently positioned on the edge of an exposed outcrop, a visible exposure of bedrock, where observations by orbiting spacecraft suggest the possible presence of small amounts of clay.

The missions of Spirit and Opportunity are part of NASA's Mars Exploration Program, which includes three previous successful landers, the two Viking probes during 1976 and the Mars Pathfinder probe in 1997. The Mars Science Laboratory, known as Curiosity, joined its counterparts on the Red Planet on Aug. 6, 2012. In September 2014, NASA's Mars Atmosphere and Volatile Evolution, or MAVEN, spacecraft is scheduled to begin orbiting the planet to study its upper atmosphere.

"All of this will pave the way for humans to travel to Mars in the 2030s," Bolden said. "Science and exploration are working together to make this historic feat possible, and we're developing technologies right now, including the Space Launch System and the Orion multipurpose crew vehicle, to take astronauts once again to deep space."



NASA file/2003

A Delta II rocket with its Mars Exploration Rover-A, or Spirit, lifts off Launch Complex 17-A at Cape Canaveral Air Force Station on June 10, 2003.



NASA file/2003

Engineers and scientists test the Mars Exploration Rover-B, also known as Opportunity, for mobility and maneuverability in Kennedy Space Center's Payload Hazardous Servicing Facility on March 21, 2003.

# KSC in 2013: Accomplishments and Milestones

From 2013, Page 1

flame deflector and brick walls. On the surface of the pad, a new elevator has been constructed. All of the crawler track panels were removed so that the concrete surface below and the catacomb roof can be inspected and repaired. New crawler track panels will be installed in 2014.

Upgrades, including new roller shaft bearings, were installed on crawler-transporter 2 so it can support the added weight of the mobile launcher and SLS on its journey to Pad 39B. Crawler-transporter 1 (CT-1) received new jacking, equalizing and leveling, or JEL, hydraulic cylinders and was taken for a test ride to Launch Pad 39A to undergo a leveling and turning test. CT-1 continues to be modernized so that it is available to carry a variety of launch vehicles to the pad.

The crawlerway leading to pads A and B was upgraded to

improve the foundation and prepare it to support the weight of the SLS and mobile launcher on the crawler-transporter during rollout. Workers removed the original Alabama river rock and restored the layer of lime rock below to its original depth of three feet. New river rock was added on top.

The Multi-Payload Processing Facility is undergoing extensive upgrades and modernizations to support processing of Orion spacecraft. The building primarily will be used for Orion hypergolic fueling, ammonia servicing and high-pressure gas servicing and checkout.

With crewed launches on the SLS and Orion spacecraft approaching, GSDO led the effort to select an emergency egress vehicle that future astronauts could use to quickly leave the Launch Complex 39 area in case of an emergency. The first of four refurbished Mine-

Resistant Ambush-Protected vehicles was shipped from the U.S. Army Red River Depot in Texarkana, Texas, and arrived at the center Dec. 5. They will be modified to meet NASA's emergency egress requirements.

## Orion

Using hydraulic actuators, the Orion crew module underwent a static loads test, which simulated the massive loads the spacecraft would experience during its mission, in the Operations and Checkout Building in April.

During the year, the main components of the Launch Abort System, or LAS, were delivered to Kennedy and are being processed in the Launch Abort System Facility. In May, the launch abort motor was connected to the attitude control motor.

The LAS is designed to safely pull the Orion crew module away from the launch vehicle in the event of an emergency on the launch pad or during the initial ascent of the SLS rocket.

In June, a series of tests on the explosive bolts that separate Orion from the launch abort system was performed on the ground test vehicle in the Launch Equipment Test Facility. Data was collected on the effect of the shock waves during the explosive bolt separation.

In August, a stationary recovery test was performed on the Orion boilerplate test article and support equipment aboard a U.S. Navy ship at the Naval Station Norfolk near NASA's Langley Research Center in Virginia.

In October, the Orion crew module was powered on for the



NASA/Dimitri Gerondidakis

An airship from the British Broadcasting Corp. (BBC) flies over Launch Complex 39 past the Vehicle Assembly Building at Kennedy Space Center on Sept. 18, 2013. A team of scientists from the BBC's television project "Cloud Lab" conducted a number of experiments aboard the airship as it flew across the U.S., exploring all aspects of the Earth's atmosphere. One of the experiments is NASA's Microorganisms in the Stratosphere, or MIST, which is designed to measure the microbial survival and cellular responses to exposure in the upper atmosphere.

first time. The spacecraft's avionics system was installed and powered up for a series of systems tests that marked a major milestone in the final year of preparations for flight.

In December, the heat shield for the Orion spacecraft arrived at Kennedy aboard the Super Guppy aircraft and was transported to the Operations and Checkout Building for processing. The largest of its kind ever built, the heat shield is planned for installation on the Orion crew module in March 2014. Also in December, one of three main parachutes for Orion arrived at Kennedy's Shuttle Landing Facility and was transported to the Operations and Checkout Building high bay for processing.



NASA/Kim Shifflett

Technicians prepare the main parachute of the Orion spacecraft for lifting by crane inside the Operations and Checkout Building high bay at Kennedy Space Center on Dec. 10, 2013. The parachute will be prepared for installation on Orion. The Orion spacecraft is being prepared for its first uncrewed flight test, Exploration Flight Test-1 (EFT-1) scheduled for launch atop a Delta IV rocket in September 2014. Orion is scheduled to launch atop NASA's Space Launch System rocket in 2017. For more about Orion, click on the photo.

## Center Planning and Development

The Center Planning and Development Directorate facilitated agreements with several companies for the use of some of Kennedy's legacy facilities.

A new partnership agreement with United Paradyne Corp. of Santa Maria, Calif., will allow the company to use the shuttle-era Hypergolic Maintenance Facility. A new partnership agreement with PaR Systems Inc. of Shoreview, Minn., will give the company use of the Hangar N facility and its unique nondestructive equipment. An agreement with Micro Aerospace Solutions of Melbourne, Fla., will allow the use of an offline

hardware processing "clean room" laboratory and office space in the center's Space Station Processing Facility.

## International Space Station and Payload Processing

NASA's Optical Payload for Lasercomm Science (OPALS), an optical technology demonstration experiment for the space station, arrived at the Space Station Processing Facility July 11 from the agency's Jet Propulsion Laboratory in Pasadena, Calif.

The nearly 600-pound experiment is being prepared for delivery to the International Space Station aboard a SpaceX Dragon commercial resup-



NASA/Jim Grossmann

The Optical Payload for Lasercomm Science (OPALS) experiment was tested at the Space Station Processing Facility offline laboratory at Kennedy Space Center on July 11, 2013. For more information about OPALS, click on the photo.

ply capsule on the company's Falcon 9 rocket early next year.

Kennedy supported the space station by integrating two Orbital Replacement Units and successfully demonstrating the high-pressure Nitrogen Oxygen Recharge System capability, which will be ready for flight fill operations in 2014. Also, workers outfitted more than 10 science labs that supported the SpaceX-2 mission.

## Technology

A meteorological airship containing a "Cloud Lab" flew over Kennedy in September, carrying components of NASA's Microorganisms in the

Stratosphere (MIST) experiment. The microbes for MIST were developed by NASA scientists at the Space Life Sciences Laboratory near the center.

In December, NASA's Project Morpheus prototype lander underwent two free-flight tests at the north end of Kennedy's Shuttle Landing Facility, near the autonomous landing and hazard avoidance technology (ALHAT) field.

Project Morpheus integrates ALHAT with an engine that runs on liquid oxygen and methane, or "green" propellants, into a fully operational lander that could deliver cargo to asteroids and other planetary surfaces.

## More online

For more about other missions and programs supported by Kennedy Space Center, visit: <http://www.nasa.gov/kennedy>

# Scenes Around Kennedy Space Center



## Space Coast Symphony honors past, present Kennedy workers with HD performance

The Space Coast Symphony Orchestra will present a special performance in appreciation of former and current Kennedy Space Center employees and their families.

The symphony will perform Gustav Holst's "The Planets" at 2 p.m. Saturday, Jan. 25, at the Scott Center for the Performing Arts at Holy Trinity Episcopal Academy, 5625 Holy Trinity Drive in Melbourne.

In addition to the music, high-definition images from NASA will be projected on a screen. This performance will highlight the space program and its impact to our local community during the past 50 years.

Advance tickets are \$10 for adults and available at <http://bit.ly/1dA16X0>

Discounted tickets also are available through the Space Coast Symphony's Symphony for Everyone Program.

Children and students 18 and younger are admitted free.

Refreshments will be available and parking is free.

For more information, call (855) 252-7276 or Rebecca Lewis of the Event Management and Guest Operations Office at (321) 867-4053.



NASA/Dimitri Gerondidakis

Members of the news media are given an up-close look at the Tracking and Data Relay Satellite (TDRS-L) spacecraft undergoing preflight processing inside the Astrotech payload processing facility in Titusville on Jan. 3. TDRS-L is being prepared for encapsulation inside its payload fairing prior to being transported to Space Launch Complex 41 at Cape Canaveral Air Force Station where it is scheduled to launch atop an Atlas V rocket Jan. 23. For more information, click on the photo.



NASA/Randy Beaudoin, VAFB

Technicians move a solid rocket motor to a different transporter inside the Solid Rocket Motor Processing Facility at Vandenberg Air Force Base in California on Dec. 19. The motor will be attached to the United Launch Alliance Delta II rocket slated to launch NASA's Orbiting Carbon Observatory-2 (OCO-2) spacecraft July 2014. OCO-2 will collect precise global measurements of carbon dioxide in the Earth's atmosphere. Scientists will analyze this data to improve our understanding of the natural processes and human activities that regulate the abundance and distribution of this important atmospheric gas. For more information about OCO, click on the photo.

# President extends ISS operations to 2024

NASA News Report

NASA and President Obama's Administration have agreed to extend the International Space Station (ISS) until at least 2024.

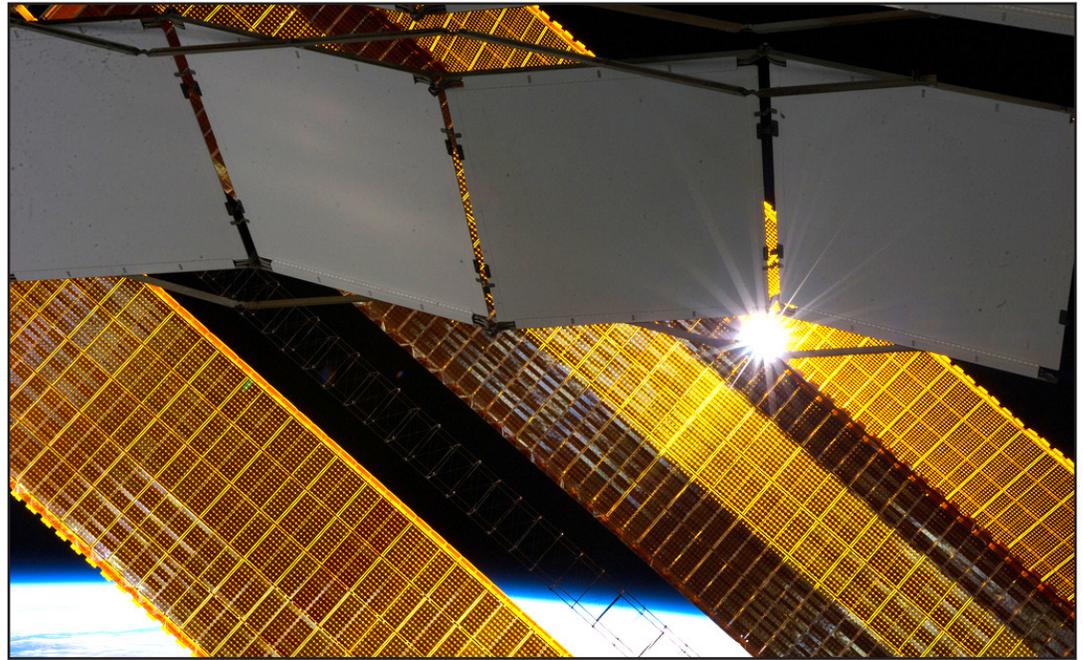
Speaking at a global space exploration forum Jan. 9, John P. Holdren, director of the White House Office of Science and Technology Policy, explained the importance of decision.

Holdren discussed the ISS extension plan at the International Space Exploration Forum (ISEF) in Washington, where leaders from more than 35 spacefaring nations gathered for the first ministerial-level meeting ever held to build political support for global cooperation in space exploration. The U.S. Department of State hosted the meeting.

"The exploration and utilization of space benefits all humankind," Secretary of State John Kerry said in a written statement. "They further promote innovation and economic development, foster scientific advancement, and inspire the next generation of explorers to pursue studies and careers in the fields of science, technology, engineering, and mathematics. Government-level involvement in and support for human and robotic space exploration are critical to realizing these benefits. The ISEF provides us with an opportunity to strengthen international cooperation through discussions of policy issues relevant to the exploration, long-term sustainability, development, and utilization of this important domain."

Holdren touted the benefits of continuing to operate the orbiting laboratory for at least another decade in his remarks.

"The ISS is a unique facility that offers enormous scientific



NASA

The sun shines through a truss-based radiator panel and a primary solar array panel on the Earth-orbiting International Space Station in this photograph taken by an Expedition 38 crew member Jan. 2.

and societal benefits," said Holdren. "The Obama Administration's decision to extend its life until at least 2024 will allow us to maximize its potential, deliver critical benefits to our nation and the world, and maintain American leadership in space."

NASA Administrator Charles Bolden emphasized in a keynote speech the importance of the role space exploration has

played in scientific discovery in space and on Earth, and the ways exploration has led to new technologies.

"NASA is committed to the space station as a long-term platform to enable the utilization of space for global research and development," Bolden said. "We're committed to implementing a unified strategy of deep space exploration, with robotic and human

missions to destinations that include near-Earth asteroids, the moon and Mars. And we are committed to our international partnerships and the continued peaceful uses of outer space and unlocking the mysteries of our vast universe."

Deputy Secretary of State William Burns spoke at the forum on behalf of the Department of State.

"We all share a deep stake in extending humanity's reach further into the solar system, advancing innovation further and faster, and extending the benefits of discovery to more people in more places," Burns said. "The question facing us today is whether we can muster the courage and political will to advance space exploration and ensure that cooperation continues to trump competition."



NASA

NASA astronaut Mike Hopkins enjoys time in the cupola, which affords the most broad views of Earth.

## More online

For more information about the International Space Station, visit: [http://www.nasa.gov/mission\\_pages/station/main/index.html](http://www.nasa.gov/mission_pages/station/main/index.html)

# SLS Avionics System sees 'first light'

NASA News Report

The modern avionics system that will guide the most powerful rocket ever built saw the light -- the "first light," that is.

Hardware, software and operating systems for NASA's Space Launch System (SLS) Jan. 9 were integrated and powered up for an inaugural run -- referred to as "first light."

When completed, SLS will be capable of powering humans and potential science payloads to deep space. It has the greatest capacity of any launch system ever built, minimizing cost and risk of deep space journeys.

"We often compare the avionics system to the body's central nervous system. We

can't function without one, and neither can the SLS," said Lisa Blue, stages avionics system manager in the SLS Program Office at NASA's Marshall Space Flight Center in Huntsville, Ala. "Avionics tell the rocket where it should go and end up, and how it should pivot the engines to keep on the right trajectory."

"Now we have that critical system together, and each unit has powered up successfully," Blue added. "That's a major accomplishment toward getting ready for the first flight of SLS."

The Integrated Avionics Test Facilities team provided and installed the structure and simulation capability to model the environments the vehicle will experience during launch.

With the avionics hardware units arranged in flight configuration on the structure and with the flight software, the facility will replicate what actually will fly the rocket. "We are using and testing state-of-the-art technology, including the most powerful computer processor ever used on a flight system," Blue said.

NASA and Boeing engineers will test the system in early January at the Systems Integration and Test Facility at Marshall. They will run flight simulations to see how SLS will perform during launch.



Photo courtesy of the Boeing Company  
Test engineer James Peckham runs an avionics flight simulation Jan. 9 to see how SLS will perform during launch.



Photo courtesy of the Boeing Company

From left, Wayne Arrington, Gerald Clayton and Ryan MacKrell, all of The Boeing Company, work on setting up the avionics system in flight configuration Jan. 9 in the Systems Integration and Test Facility at NASA's Marshall Space Flight Center.

## NASA Employees of the Month: January



NASA/Tony Gray

Employees of the Month for January are, from left, Jennifer C. Boelke, Engineering and Technology; Susan E. Danley, Engineering and Technology; William W. Benson, Launch Services Program; Elizabeth D. Wise, Education and External Relations (Employee of the Quarter); and Liliana P. Villarreal, Ground Processing. Not pictured are Trey M. Carlson, Center Planning and Development; Kenneth E. Tenbusch, Commercial Crew Program (FA) (Employee of the Quarter); Josiel Torres, IT and Comm Services (Employee of the Quarter); Brian J. Rutkowski, Ground Systems Development and Operations; Ashley M. Keegan, Procurement; Mary A. Thompson, Safety and Mission Assurance; Taylor M. Pitcock, Center Operations; and Fayann Hull, ISS and Spacecraft Processing (Employee of the Quarter).

## Looking up and ahead . . .

Jan. 23

**Mission:** Tracking and Data Relay Satellite-L (TDRS-L)

**Launch Vehicle:** Atlas V

**Launch Site:** Cape Canaveral Air Force Station, Fla.

**Launch Window:** 9:05 to 9:45 p.m. EST

**Launch Pad:** Space Launch Complex 41

**Description:** TDRS-L is the second of three next-generation satellites designed to ensure vital operational continuity for the NASA Space Network.

To watch a NASA launch online, go to <http://www.nasa.gov/ntv>.



John F. Kennedy Space Center

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