Dec. 2, 2013 Vol. 53, No. 22

Spaceport News

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

Morpheus lander arrives for testing

By Linda Herridge
Spaceport News

NASA's Project Morpheus prototype lander arrived at Kennedy Space Center on Nov. 21 and was transported to a support building at the Shuttle Landing Facility to be prepared for tethered and free-flight testing. The lander is a test bed to demonstrate new green propellant propulsion systems and autonomous landing and hazard detection technology, which could enable new capabilities for future human exploration of the solar system.

Nearly six months of Morpheus tethered tests were accomplished at the Vertical Testbed Flight Complex near NASA's Johnson Space Center (JSC) in Houston before the lander was packed and shipped to Kennedy.

"All of the testing we accomplished at JSC was preparing us for the free-flight tests at Kennedy," said Jon Olansen, the Morpheus project manager at Johnson.

During its final test at Johnson, Morpheus was launched over a flame trench, ascended to a height of 21 feet, and flew a course that landed the vehicle on a separate pad 10 feet from its launch point. The vehicle remained loosely tethered, which provided the necessary range safety at the center, but limited flight distances.

Olansen said the Johnson tests helped the team understand how the vehicle performs and how to fine tune it. Testing also demonstrated the capability of a number of Morpheus' backup systems.

NASA/Kim Shiflett

Technicians position the Project Morpheus lander onto a transporter inside a support building at the Shuttle Landing Facility at Kennedy Space Center Nov. 21.

More online
For more about Morpheus, visit
http://morpheuslander.jsc.nasa.gov/.

Now, Morpheus will be tested at the north end of the Kennedy landing facility, where a realistic crater-filled planetary scape awaits. The 100-square-meter field, called the Autonomous Landing and Hazard Avoidance Technology (ALHAT) Hazard Field, contains rocks and other hidden hazards designed to mimic as closely as possible the landing conditions on surfaces such as the moon or Mars.

Greg Gaddis, the Kennedy Morpheus and ALHAT site manager said an in-field checkout of Morpheus' communication and safety systems will be completed Dec. 3 to confirm they are functioning properly. On Dec. 4, Morpheus will be loaded with propellant, liquid oxygen and liquid methane, to verify the systems are working.

"During the first flight campaign, the team will conduct dry run operations to wring out any Kennedy-specific challenges to support Morpheus testing," Gaddis said.

Morpheus' first tether test will take place Dec. 6 at the launch pad constructed at the north end of the landing facility, just south of the hazard field. The tethered lander will be raised 20 feet high to minimize risk to the vehicle while a checkout flight is conducted to ensure it performs as expected after being shipped across the country. The vehicle will ascend 10 feet, move laterally 10 feet, then return to center and "land" at the bottom of the tether.

On Dec. 10, the first of three autonomous free-flight tests is planned. Morpheus will be loaded with propellants, lift off from a recently constructed transportable pad containing a flame trench, hover at about 50 feet in altitude, then move over and land on the second pad, a little more than 23 feet away.

"Over the next few months, we will continually expand Morpheus' flight envelope with a goal of reaching over 800 feet in altitude and moving more than 1,500 feet downrange," Olansen said.

The Morpheus lander eventually will incorporate ALHAT, a technology that will allow it to navigate to clear landing sites amidst rocks, craters and other hazards during its descent.

Morpheus is being managed under the Advanced Exploration Systems Division in NASA's Human Exploration and Operations Mission Directorate. The efforts in the Advanced Exploration Systems pioneer new approaches for rapidly developing prototype systems, demonstrating key capabilities and validating operational concepts for future human missions beyond Earth orbit.

Satellite servicing capability testing ongoing

By Bob Granath
Spaceport News

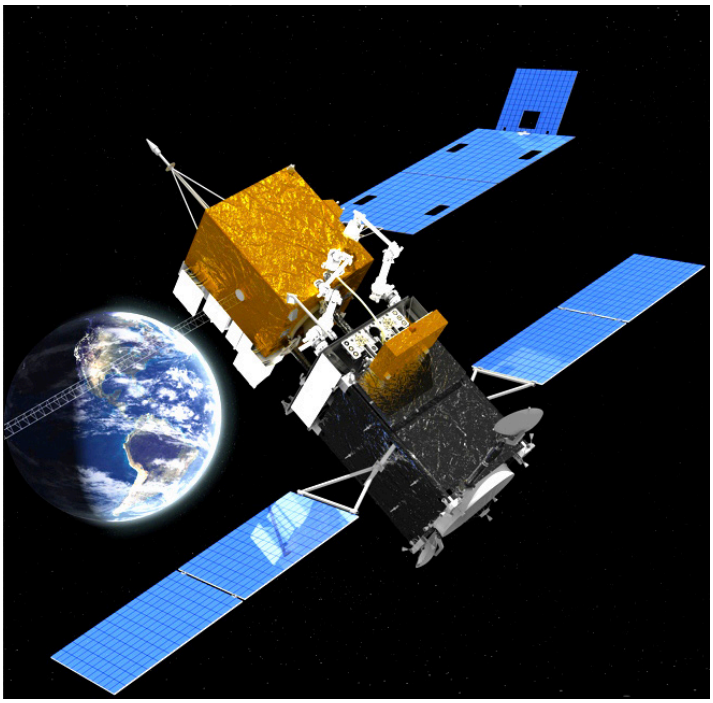
Since the first satellites were launched during the late 1950s, daily life has become more and more dependent on spacecraft orbiting the Earth

From time to time, these spacecraft experience failures or simply run out of the propellant necessary to keep them operating properly. Engineers at Kennedy Space Center are partnering with counterparts at the agency's Goddard Space Flight Center in Maryland to develop systems to bring potential future robotic "service tow trucks" to orbiting spacecraft in need of aid.

Operating under Goddard's Satellite Servicing Capabilities Office's (SSCO) technology development effort, the project is now moving into the next phase with a team at Kennedy developing a reliable and accurate prototype high-pressure propellant transfer assembly using lessons learned from recent testing.

Tom Aranyos, technical integration manager in NASA's Fluids and Propulsion Division at Kennedy, is leading the team of NASA and contractor specialists that built and assess performance of the propellant transfer system's engineering development unit (EDU).

The system was designed to demonstrate that a robotically operated satellite could refuel another orbiting spacecraft within required typical mission operating parameters.



NASA

In this artist's concept, a servicing satellite (right) robotically repairs a client spacecraft. Satellites are expensive to build and launch. There could be a tremendous savings by keeping them in good operating order for longer periods of time.

"Historically, we receive, process and launch spacecraft developed at other centers," Aranyos said. "That's given us an extensive knowledge base and diverse capabilities. The satellite servicing project gives us an opportunity to put that experience to work."

As now conceived by Goddard's SSCO, the robotic servicer spacecraft would be equipped with the technology it needs to autonomously rendezvous with satellites needing assistance. The servicer would be equipped with a state-of-the-art navigation system, enhanced robotic arms and tools, along with a supply of propellant.

"As part of the Goddard team, we are performing the design, development and qualification testing of the critical hypergolic propellant pumping transfer system," said Aranyos. "We're very confident that the technology will work as designed."

That confidence is based on NASA's years of experience in satellite servicing and robotic operations.

"The same approaches that were used in successfully servicing the Hubble Space Telescope are being applied to this mission," Aranyos said.

Erik Tormoen, also of NASA Engineering and Technology, added that it is crucial to know how things perform differently in microgravity.

Aranyos said the next step will be demonstrating remote, teleoperated robotic transfer line-mating/disconnect tests combined with hypergolic propellant flow testing. These efforts are now scheduled for February 2014 at Kennedy's Payload Hazardous Servicing Facility.

The recent testing at Kennedy is a crucial step in developing satellite servicing capability, as the project would be an important aid to an ever-growing number of orbiting spacecraft that play key roles in communications, science, defense and weather monitoring.

"You must perform tests in the environment the hardware will be in when operating in space," said Syrus Jeanes of NASA's Engineering and Technology Directorate. "Then you can correlate the test results with computer models. This gave us a high degree of confidence that our designs will work as expected."

Tormoen said, "This has the potential to help enable a future U.S. industry providing servicing spacecraft. Satellites are expensive to build and launch. There could be a tremendous savings by keeping them in good operating order for longer periods of time."

NASA

According to Tom Aranyos, technical integration manager in NASA's Fluids and Propulsion Division, this team comprised of NASA and contractor specialists built the engineering development unit (EDU) of a propellant transfer system and "delivered on all promises for development and risk-reduction test efforts."

NASA bolsters next phase of CCP with CCtCap

By Rebecca Regan
Spaceport News

NASA took another step Nov. 19 to restore an American capability to launch astronauts from U.S. soil to the International Space Station by the end of 2017, subject to the availability of adequate funding. The agency's Commercial Crew Program (CCP) requested proposals from U.S. companies to complete development of crew transportation systems that meet NASA certification requirements and begin conducting crewed flights to the space station.

"NASA is committed to launching American astronauts from U.S. soil in the very near future, and we're taking a significant step toward achieving that goal," NASA Administrator Charles Bolden said. "Our American industry partners have already proven they can safely and reliably launch supplies to the space station, and now we're working with them to get our crews there as well. However, we will require that these companies provide spacecraft that meet the same rigorous safety standards we had for the space shuttle program, while providing good value to the American taxpayer."

This phase of the CCP, called Commercial Crew Transportation Capability (CCtCap), will enable NASA to ensure a company's crew transportation system is safe, reliable and cost-effective. The certification process will assess progress throughout the production and testing of one or more integrated space transportation systems, which includes rockets, spacecraft and ground operations. Requirements under CCtCap also will include at least one crewed flight test to the space station before certification can be granted.

NASA image/Greg Lee

This artist concept features a NASA astronaut, the Earth and the International Space Station. The Earth focuses on the United States, from which NASA's Commercial Crew Program plans to safely launch astronauts using commercially developed space transportation capabilities by the end of 2017. To download a high resolution of this graphic, click the photo.

"The U.S. commercial space industry has made tremendous progress designing and developing the next generation of U.S. crew transportation systems for low-Earth orbit," said William Gerstenmaier, NASA's associate administrator for Human Exploration and Operations in Washington. "Finalizing these systems in accordance with NASA's certification requirements will not be easy. The acquisition approach we are using is designed to leverage the innovative power of industry with the expertise, skill and hard-learned lessons from NASA. This request for proposals begins the journey for a new era in U.S. human spaceflight."

As with all of NASA's human spaceflight activities, astronaut safety will be a priority. CCtCap ensures a strong emphasis on crew safety through its requirements, including NASA insight throughout development and thorough testing of the space transportation systems.

"NASA is taking its years of expertise in human spaceflight systems and partnering with industry to develop a safe and reliable crew transportation system for NASA and for the nation," said Phil McAlister, NASA's director of commercial spaceflight development. "These certification contracts are part of a strategy that will help ensure human safety."

NASA expects to award one or more CCtCap contracts no later than September 2014.

CCtCap is the second phase of a two-phased effort that began last year. It builds on the accomplishments of a first certification phase, called Certification Products Contracts (CPC). CPC required companies to deliver a range of products that establish a baseline for their integrated system certification. CCtCap is open to any company with systems at the design maturity level consistent with the completion of the first certification phase.

CCtCap contractors will plan, manage and execute long-term production and operational plans for their systems. The firm-fixed price contracts, based on the Federal Acquisition Regulations (FAR), will include at least one crewed flight test to verify the spacecraft can dock to the space station and that all its systems perform as expected. CCtCap contracts also will include at least two and as many as six crewed, post-certification missions to enable NASA to meet its station crew rotation requirements.

While CCtCap will enable NASA to acquire a capability to transport crews to the space station, systems developed by U.S. industry can be marketed and used by other customers.

As NASA works with U.S. industry partners to develop commercial spaceflight capabilities to low-Earth orbit, the agency also is developing the Orion spacecraft and the Space Launch System (SLS), a crew capsule and heavy-lift rocket to provide an entirely new capability for human exploration. Designed to be flexible for launching spacecraft for crew and cargo missions, SLS and Orion will expand human presence beyond low-Earth orbit and enable new missions of exploration across the solar system.

More online

For more information about NASA's Commercial Crew Program, visit **http://www.nasa.gov/commercialcrew**. To view the CCtCap Request for Proposals, visit **http://go.nasa.gov/I3ApC1**.

Scenes Around Kennedy Space Center

NASA/Kim Shiflett

Construction workers continue to remove the bricks from the flame trench walls that are below and between the left and right crawlerway tracks at Kennedy's Launch Pad 39B Nov. 19. The space shuttle-era flame trench has been completely removed. Launch Pad 39B is being refurbished to support NASA's Space Launch System and other launch vehicles. The Ground Systems Development and Operations, or GSDO, Program office at Kennedy is leading the center's transformation to safely handle a variety of rockets and spacecraft. For more information about GSDO, click the photo.

NASA/Jim Grossmann

Students and mentors gather in the KSC Training Auditorium Nov. 20 at an assembly sponsored by the Disability Awareness and Action Working Group (DAAWG) for Disability Mentoring Day. The group paired students and job seekers with disabilities with mentors across the center.

NASA/Tony Gray and Rick Wetherington

The United Launch Alliance Atlas V rocket carrying NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft lifts off Space Launch Complex 41 on Cape Canaveral Air Force Station Nov. 18. After a 10-month journey to the Red Planet, MAVEN will study its upper atmosphere in unprecedented detail from orbit above the planet. Built by Lockheed Martin in Littleton, Colo., MAVEN will arrive at Mars in September 2014 and will be inserted into an elliptical orbit with a high point of 3,900 miles, swooping down to as close as 93 miles above the planet's surface. For more information, click the photo.

NASA/Glenn Benson

A member of the Launch Services Program team monitors systems on the United Launch Alliance Atlas V rocket from the Mission Director's Center in Hangar AE on Cape Canaveral Air Force Station as the countdown progresses smoothly to launch of NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft from Space Launch Complex 41 Nov. 18.

NASA/Glenn Benson

Members of the Launch Services Program team monitor systems on the United Launch Alliance Atlas V rocket from the Launch Vehicle Data Center in Hangar AE on Cape Canaveral Air Force Station as the countdown progresses smoothly to launch of NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft from Space Launch Complex 41 Nov. 18.

MPPF upgrades will support Orion processing

By Linda Herridge
Spaceport News

The Multi-Payload Processing Facility (MPPF) at Kennedy Space Center is undergoing extensive upgrades and modernizations to support processing of Orion spacecraft for the agency's exploration missions. The building once supported the processing of various payloads and spacecraft for the agency's Space Shuttle and Launch Services Programs.

The 19,647-square-foot building, originally constructed in 1995, primarily will be used for Orion hypergolic fueling, ammonia servicing and high-pressure gas servicing and checkout before being transported to the Vehicle Assembly Building for integration with the Space Launch System.

"We're looking forward to completion of construction, ground systems installation and verification and validation of those systems," said Skip Williams, Ground Systems Development and Operations (GSDO) deputy project manager for the spacecraft offline element integration team.

The facility also will be used to install time-critical crew equipment and to process crew modules that have returned from space to be returned to the Operations and Checkout Building for possible reuse. Ground support equipment also will be stored and maintained in the MPPF.

GSDO is overseeing the upgrades to accommodate the Orion spacecraft. These upgrades include installing new pneumatics systems for gaseous helium, gaseous oxygen, gaseous nitrogen and breathable air; hypergolic systems for monomethylhydrazine, hydrazine and nitrogen tetroxide, and a ground cooling system.

New ducts are being installed to support the environmental control system, and a crew module wash-down station is being constructed. Structural updates to the building include replacing the main high bay door to meet current hurricane codes and installing an emergency egress exterior staircase to meet life safety codes.

> ***"We're looking forward to completion of construction, ground systems installation and verification of those systems."***
>
> **Skip Williams**, NASA's GSDO Deputy Project Manager for Spacecraft Offline Element Integration Team

The hypergolic vapor exhaust system, universal substation and uninterruptable power station will be replaced, and a new emergency generator and fuel tank will be installed. The current communication room will be retrofitted with new systems, including a ground control system that will interface with Launch Control Center Firing Room 1.

According to Williams, the unique facility could be available to multiple customers for use between Orion flight processing.

Speegle Construction of Cocoa, Fla., is the prime contractor performing the work. Upgrades and modifications to the MPPF are scheduled to be completed by April 2015.

NASA/Skip Williams

New environmental control system piping has been installed at the Multi-Payload Processing Facility at Kennedy Space Center, shown here Nov. 5.

NASA/Skip Williams

Workers complete construction of the emergency egress stairway on the exterior of the Multi-Payload Processing Facility at Kennedy Space Center Nov. 5.

First Mach 2 achieved at Dryden 60 years ago

By Peter Merlin
Dryden Flight Research Center

Sixty years ago, A. Scott Crossfield, a talented young engineering research pilot for the National Advisory Committee for Aeronautics (NACA), became the first human to fly faster than twice the speed of sound in the Douglas D-558-2 Skyrocket in the skies over Edwards Air Force Base.

NASA's Dryden Flight Research Center celebrated the 60th anniversary of the milestone Nov. 20 during colloquium presentations by Dr. Richard P. Hallion, a research associate in aeronautics for the Smithsonian National Air and Space Museum and former Edwards base historian and author of "On the Frontier," NASA Dryden's official history.

During his "Rocketing Through Mach 2" presentations at Dryden and at Antelope Valley College in nearby Lancaster that evening, Hallion emphasized that the event's purpose was threefold: to recognize Dryden as a center of excellence for aeronautics research; to pay tribute to a remarkable aircraft, the Douglas D-558-2 Skyrocket; and to honor Crossfield, who flew the Skyrocket to a speed of Mach 2.005 -- roughly 1,300 mph at 62,000 feet altitude -- Nov. 20, 1953.

The Skyrocket was one of several aircraft flown in the Rocket Airplane Research Program, a joint NACA, Air Force and Navy project established in 1944 to explore the problems of transonic and supersonic flight.

"The initial designs for transonic research airplanes were very simple," said Hallion. "Fuselage shapes were typically based on the .50 caliber bullet."

NASA file/1953

Scott Crossfield with the Douglas D-558-2 Skyrocket following the Mach 2 record flight Nov. 20, 1953.

NASA file/1953

The Art Deco profile of the Douglas-D-558-2 Skyrocket made it "one of the most elegant research airplanes ever built," according to Dr. Richard P. Hallion, research associate in aeronautics at the Smithsonian National Air and Space Museum.

Three Skyrockets – NACA No.143, 144 and 145 -- were built and flown with various combinations of jet and rocket propulsion. When powered by a single 3,000-pound-thrust jet engine, the D-558-2 required a takeoff roll as long as three miles unless augmented with auxiliary rocket thrusters. The airplane was later equipped with both the jet plus a 6,000-pound-thrust, four-chambered, liquid-fueled rocket engine, and some flights were flown solely under rocket power.

Researchers made the most of the Skyrocket's limited fuel supply, extending flight duration by carrying the research airplane aloft beneath a specially modified B-29 bomber – redesignated P2B-1S by the Navy -- and releasing it at altitudes of about 35,000 feet. Designed by Douglas Aircraft Company's Ed Heinemann, the D-558-2 had an Art Deco profile that made it, in Hallion's opinion, "one of the most elegant research airplanes ever built."

"If we look at the Skyrocket, we really see the genius of one of America's great aircraft designers," Hallion said. "This is an extremely streamlined, highly refined design."

Although the Skyrocket was only designed to reach Mach 1.5, the NACA team was confident that it could reach Mach 2 under certain conditions. In preparation for the attempt, Skyrocket No. 144 was cleaned and polished to reduce drag, and the fuel was cold-soaked to minimize its volume and maximize the amount that could be stored in its tanks.

Following launch from the P2B-1S, Crossfield ignited the rocket motor and climbed to 72,000 feet altitude. He then nosed the Skyrocket over into a shallow dive and gradually accelerated, edging through Mach 2 at about 62,000 feet. After the engine's fuel was expended, the airplane slowed, easing back through the transonic region into a subsonic glide. Crossfield ended the 12-minute flight with a 360-degree roll followed by a smooth landing on Rogers Dry Lake, Hallion related.

Crossfield's record speed in the Douglas Skyrocket would not last long. Only 22 days later, Air Force Capt. Charles E. "Chuck" Yeager flew the Bell X-1A rocket plane to 1,612 mph, almost Mach 2.5.

Following completion of the D-558-2 Skyrocket research program in 1956, Skyrocket No. 144 was placed on display in the Smithsonian Institution's National Air and Space Museum in Washington, D.C. The other two Skyrockets remained in California -- No. 145 on exhibit at Antelope Valley College in Lancaster and No. 143 on display at the Planes of Fame Museum in Chino.

"I am an aeronautical engineer, an aerodynamicist, and a designer," Crossfield said in a 1988 interview. "My flying was primarily because I felt that it was essential to designing and building better airplanes for pilots to fly."

Looking up and ahead . . .

**** All times are Eastern***

2013

Dec. 17
Mission: Orbital 1 Commercial Resupply Services flight
Launch Vehicle: Antares
Launch Site: Wallops Flight Facility, Va.
Launch Pad: Mid-Atlantic Regional Spaceport Pad-0A
Launch Time: 10:07 p.m.
Description: Orbital 1 will be the first commercial resupply mission to the International Space Station by Orbital Sciences.

2014

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 to 11 p.m.
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.

Feb. 22
Mission: SpaceX-3 Commercial Resupply Services flight
Launch Vehicle: Falcon 9
Launch Site: Cape Canaveral Air Force Station, Fla.
Launch Pad: Space Launch Complex 40
Launch Time: TBD
Description: SpaceX-3 will be the third commercial resupply mission to the ISS by Space Exploration Technologies (SpaceX).

March 26
Mission: Expedition 39/40
Launch Vehicle: Soyuz 38
Launch Site: Baikonur Cosmodrome, Kazakhstan
Launch Time: TBD
Description: Soyuz 38 will carry to the International Space Station Russian cosmonauts Alexander Skvortsov and Oleg Artemyev, both Expedition 39/40 flight engineers; and NASA astronaut Steve Swanson, Expedition 39 flight engineer and Expedition 40 commander.

April
Assembly Flight: 3R
Mission: Multipurpose Laboratory Module with European Robotic Arm (ERA)
Launch Vehicle: Russian Proton
Launch Site: Baikonur Cosmodrome, Kazakhstan
Launch Time: TBD
Description: A Russian Proton rocket will deliver the Multipurpose Laboratory Module with European Robotic Arm (ERA) to the International Space Station.

May 28
Mission: Expedition 40/41
Launch Vehicle: Soyuz 39
Launch Site: Baikonur Cosmodrome, Kazakhstan
Launch Time: TBD
Description: Soyuz 39 will carry to the International Space Station Russian cosmonaut Maxim Suraev, Expedition 40 flight engineer and Expedition 41 commander; along with NASA astronaut Reid Wiseman and European Space Agency astronaut Alexander Gerst, both Expedition 40/41 flight engineers.

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

NASA Employees of the Month: November

NASA/Kevin O'Connell

Employees of the Month for November are, from left, Jeffery M. Osgood, Safety and Mission Assurance; Barbara Cox, IT and Comm Services (Employee of the Quarter); Cathy T. Gieseler, Procurement; Rose A. Dougherty, Human Resources (Employee of the Quarter); Jack E. Strieter, Engineering and Technology. Not pictured are Robert J. Hubbard, Center Planning and Development; Jennifer J. Stahre, Chief Counsel; Fayann Hull, Commercial Crew Program, (Employee of the Quarter); Barbra M. Calvert; Ground Processing; Rogelio Franco, Ground Systems Development and Operations; Matthew G. Parris, Engineering and Technology; Dorothea C. Kight, Center Operations; and Clarise (Cricket) Stevenson, Launch Services Program.

NASA Employees of the Month: December

NASA/Kevin O'Connell

Employees of the Month for December are, from left, Theodore B. Meade, Safety and Mission Assurance; and Anne M. Chrest, Center Operations. Not pictured are Celia A. Brandt, Ground Processing; Eric K. Perritt, Ground Systems Development and Operations; John R. Posey, Engineering and Technology; John K. Trautwein, Engineering and Technology; Stephanie A. Martin, Public Affairs (Employee of the Quarter); Anna Vastola, Launch Services Program; and Kristian D. Rouillard, Office of the Chief Financial Officer.

John F. Kennedy Space Center

Spaceport News

Spaceport News is an official publication of the Kennedy Space Center. Contributions are welcome and should be submitted three weeks before publication to Public Affairs, IMCS-440. Email submissions can be sent to **KSC-Spaceport-News@mail.nasa.gov.**

Managing editor . . . . . Chris Hummel
Editor . . . . . Frank Ochoa-Gonzales
Assistant editor . . . . . Linda Herridge
Copy editor . . . . . Kay Grinter

Editorial support provided by Abacus Technology Corp. Writers Group.
NASA at KSC on the Web, at **http://www.nasa.gov/kennedy**
SP-2013-11-256-KSC • NASA Kennedy Space Center Public Affairs