The Marshall Star

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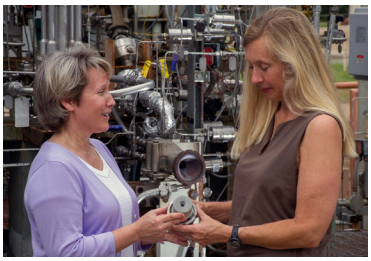

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Marshall's Upgraded Payload Integration Center Enhances Station Work

By Jessica Eagan

When International Space Station Program Manager Michael Suffredini visited the Marshall Space Flight Center last week, he told payload science controllers to prepare to be busy. This year, the team has helped station crews set records for performing science experiments. Now they have a new control room that will help them break more research records.

On June 19, NASA unveiled the

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From right, Marshall Center's Mission Operations Laboratory Manager Jay Onken, Marshall Deputy Director Teresa Vanhooser and International Space Station Program Manager Michael Suffredini congratulate Daniel Shafer, an operations controller, as well as the rest of the Payload Operations Integration Center team for the record number of science investigations completed this year. (MSFC/Emmett Given)

SLS Work Forges Ahead at Key NASA Facilities

By Megan Davidson

NASA officials unveiled a new Vertical Weld Center on June 21 at the agency's Michoud Assembly Facility -- furthering progress on production of the Space Launch System (SLS), NASA's new heavy-lift rocket.

Among those taking part in the ribbon cutting for the new tool were William Gerstenmaier, NASA associate administrator for Human

*See **SLS Forges Ahead** on page 3*

NASA, Boeing and government officials -- including William Gerstenmaier, NASA associate administrator for Human Exploration and Operations, at center, cutting the ribbon -- celebrated the unveiling of the Vertical Weld Center at Michoud. (NASA/MAF)

Payload Integration Center *Continued from page 1*

payload operations control room with new capabilities to enhance collaboration and enable the ground team to efficiently help the International Space Station crew and researchers around the world perform cutting-edge science in the unique space environment.

The Payload Operations Integration Center -- which began around-the-clock operations March 19, 2001 -- plans and coordinates all the research activities on the space station. Since NASA and 15 international partners completed station assembly in 2011, crews have devoted more time to conducting space station science.

NASA managers at the ceremony included Suffredini, Joel Montalbano, deputy manager for Utilization of the Station; Rod Jones, manager of the Station Research Integration Office; Julie Robinson, program scientist for the Station Program; Patrick Scheuermann, Marshall director; Teresa Vanhooser, Marshall deputy director; and Jay Onken, manager of Marshall's Mission Operations Laboratory.

"Conducting cutting-edge research that benefits space exploration as well as life on Earth is a top priority for the space station," said Suffredini. "With this amazing in-space laboratory now fully functional, the crews are able to dedicate more time each week to scientific research and the payload operations team at Marshall has had a major role in making that happen."

The renovated room features a video wall that expands the ability to share information, such as live video, diagrams and photographs of experiments or displays on experiment power usage or scientific data acquisition. The wall instantly allows the data to be shared by the full team and has the capability to show multiple data and video views related to one or more experiments. With more than 200 experiments on the station at any time, sharing information rapidly among the ground team members and the crew in space is important.

"Over the course of the last 12 years, our team has learned much about how they can collaborate to maximize science return," said Onken. "They used this knowledge to redesign the control room to have the most modern technical equipment to support the most amazing international engineering and scientific endeavor of the century."

On June 19, NASA unveiled an upgraded Payload Operations Integration Center at the Marshall Space Flight Center. The operation center's new capabilities enhance collaboration and enable the ground team to efficiently help the International Space Station crew and researchers around the world perform cutting-edge science in the unique space environment. (NASA/MSFC/Emmett Given)

"We recently achieved a major milestone exceeding the goal of completing an average of 37 hours of crew-tended science per week across a six month period," said Carmen Price, leader of the payload operations integration function at Marshall. "Our team even helped the crew achieve a record 72 hours of crew-tended science experiments -- the most hours of science ever conducted by a space station crew in a single week. While the crew is sleeping, we are here conducting experiments remotely from Earth, ensuring numerous automated experiments have the power and data recording and transmission needed to operate successfully."

From the Apollo Program to Skylab to Shuttle/Spacelab missions, Marshall engineers and scientists have collaborated to provide both space-based and ground-based science research facilities for the NASA science community. In addition to its operations role, Marshall manages many science facilities that house station experiments and the Environmental Control and Life Support System that makes it possible for people to live on the station.

For the latest information on the International Space Station, visit http://www.nasa.gov/station.

Eagan, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

SLS Forges Ahead *Continued from page 1*

Exploration and Operations; Dan Dumbacher, NASA Exploration Systems Development director; Patrick Scheuermann, NASA Marshall Space Flight Center director; Roy Malone, Michoud Assembly Facility director; Todd May, Space Launch System Program manager at the Marshall Center; and other officials from NASA and The Boeing Company.

The Vertical Weld Center will weld barrel panels together to produce whole barrels for SLS's core stage, which will consist of two pressurized tanks, the Intertank, the Forward Skirt and the Aft Engine Section. The core stage, towering more than 200 feet (61 meters) tall with a diameter of 27.6 feet (8.4 meters), will store cryogenic liquid hydrogen and liquid oxygen that will feed the vehicle's RS-25 engines.

The Vertical Weld Center stands about three stories tall and weighs 150 tons. Boeing is the prime contractor for the SLS core stage, including avionics. (Please see the related story in this issue of the Marshall Star about the SLS tools in development at Michoud.)

"It seems like a long way away when we talk about 2017 or talk about 2021, but when you think about all the manufacturing, work, hardware, and all the systems and design work that needs to come together, it's not that far away," Gerstenmaier said. The first SLS mission -- Exploration Mission 1 -- in 2017 will launch an uncrewed Orion spacecraft to demonstrate the integrated system performance of the SLS rocket and spacecraft prior to a crewed flight. The second SLS mission, Exploration Mission 2, is targeted for 2021 and will launch Orion and a crew of up to four American astronauts.

Mike Kynard, center, manager of the SLS Liquid Engines Office at the Marshall Center, talks to visitors in foreground about the RS-25 engines during a tour of the engine processing facility at Stennis. The engines will power the SLS core stage. (NASA/Stennis)

At Michoud, Gerstenmaier and Dumbacher saw some of the facility's manufacturing operations, where work is advancing on the SLS and Orion spacecraft programs.

Gerstenmaier, Dumbacher and other NASA officials also participated in an employee town hall and recognition event at Michoud. Five NASA Silver Snoopy awards -- presented by NASA astronaut Ricky Arnold -- and two team awards were given to Michoud employees. The Silver Snoopy is awarded for outstanding achievements related to human flight safety or mission success. It is presented personally by NASA astronauts, as it represents the astronauts' own recognition of excellence.

"When I look out here and see all these faces, all this excitement, I see the team that's going to be putting together that next vehicle that will take us beyond low-Earth orbit, beyond the moon, and that will move humans to places we've never been before," Gerstenmaier said. "Each one of you here in this group will start that foundation and start that movement towards this great, great adventure that we are about ready to go on."

Gerstenmaier and Dumbacher also visited NASA's Stennis Space Center to tour the engine processing facility, which houses the RS-25 SLS core stage engines; the B-2 test stand, which is being restored in preparation for testing of the SLS core stage; and the A-1 test stand, where the J-2X engine E10002 is testing. During the new series of tests, the engine will be gimbaled, or pivoted, during test firings.

Marshall manages the SLS Program for the agency.

Davidson, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

ATHENA Software Platform Selected as Marshall's 20th Annual Software of the Year Award Recipient

By Carolyn E. McMillan

A team of MSFC Information Technology Services (MITS) innovators has been selected as the recipient of the 2013 Marshall Space Flight Center 20th Annual Software of the Year Award for its work on the ATHENA Software Platform. Team members are employees of Dynetics Technical Services, Inc. and MEI Technologies.

The ATHENA software was developed for, and is now deployed in, the Materials and Processes Laboratory in the Marshall Engineering Directorate. ATHENA is a turnkey solution that allows the development team to create a unique Web presence or site by providing users with access to specific subject matter data via a Web browser. The platform can be used for multiple projects and multiple customers without the need to develop and build single-use information technology applications.

"We are very proud of the ATHENA Software Platform Team," said Wendell Colberg, materials and processes laboratory director. "Materials data information in the platform is not available elsewhere. It has been critical to agency programs and projects and is serving the needs of our partners in industry and academia cost effectively. With recent informatics upgrades to ATHENA, we are opening doors to multiplicative productivity in advancing knowledge inherent in the data, leading to new advances in science and engineering."

Since its development, the ATHENA platform has been used successfully to support the Materials and Processes Technical Information System (MAPTIS), the Materials International Space Station Experiment (MISSE), the Lunar E-Library and the Satellite Contamination and Materials Outgassing Knowledgebase (SCMOK).

Center Director Patrick Scheuermann has recommended ATHENA to NASA Headquarters as the Marshall Center submission for the agency's annual Software of the Year competition. The annual NASA Software of the Year Award is a prestigious honor designed to give recognition to developers of innovative software tools created for or by NASA and owned by NASA. Team members made their presentation to the NASA Inventions and Contributions Board Software of the Year Panel on June 19.

The ATHENA Software Platform Team, selected to receive the Marshall 20th Annual Software of the Year Award, will be recognized at the annual Marshall awards ceremony in July. Front row, from left, are Sopo Yung, Dynetics Technical Services, Inc.; Rick Serwecki, Dynetics; Pete Allison, MEI Technologies, supporting the Materials & Processes Laboratory; Bill Elliot, Dynetics, supporting the Application, CRM & Multimedia Office; Julia Reynolds, MEI; Ben Henrie, Dynetics; and Ginger Pierce, Dynetics, supporting the Materials & Processes Laboratory. Back row, from left, are Larry Mylin, MEI; Chris Daniel, Dynetics; Tab Black, Dynetics; Peter Rackauskas, MEI; Paul Wimberley, Dynetics; and Eric Jackson, Dynetics, supporting the Materials & Processes Laboratory.

The ATHENA software team will be recognized at the annual Marshall awards ceremony in July.

McMillan is the New Technology Representative at Marshall and the NASA Inventions and Contributions Board Awards Liaison Officer for Marshall.

NASA's Space Launch System Program Kicks Off Preliminary Design Review

By Megan Davidson

NASA kicked off the preliminary design review June 18-19 for its Space Launch System (SLS) -- the agency's new heavy-lift rocket. This major program assessment will allow development of SLS to move from concept to initial design.

"The preliminary design review is incredibly important, as it demonstrates the SLS design meets all system requirements within acceptable risk constraints, giving us the green light for proceeding with the detailed design," said Todd May, manager of the SLS Program at NASA's Marshall Space Flight Center. "We are on track and meeting all the milestones necessary to fly in 2017."

The preliminary design review process includes meticulous, detailed analyses of the entire launch vehicle. Representatives from NASA, its contractor partners and experts from across the aerospace industry validate elements of the rocket to ensure they can be safely and successfully integrated.

The review process will take several weeks and is expected to conclude this summer.

The SLS is targeted for a test launch with no crew aboard in 2017, followed by a mission with astronauts to study an asteroid by as early as 2021. NASA is developing the SLS and its new Orion spacecraft to provide an entirely new capability for human exploration. It will be flexible for launching spacecraft for crew and cargo missions, expand human presence beyond low-Earth orbit and enable new missions of exploration in the solar system.

Todd May, left, manager of the SLS Program at the Marshall Center, discusses the rocket's specifications with LeRoy Cain, who heads the independent standing review board for SLS, during the SLS Program's preliminary design review. The review kicked off June 18-19. (NASA/MSFC/Emmett Given)

Davidson, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

Space Launch System: Tooling Up to Build the World's Largest Rocket

By Megan Davidson

A wrench and hammer might be good for some building projects, but the nuts and bolts found in a standard garage toolbox definitely wouldn't hit the nail on the head when it comes to constructing a 321-foot, 5.5 million-pound rocket.

That's why engineers at NASA's Michoud Assembly Facility are installing massive tools -- one more than 170 feet tall -- specifically designed and built to weld together pieces of the core stage of the Space Launch System (SLS) -- NASA's new heavy-lift rocket that will send humans to deep space destinations, including an asteroid and Mars.

"One of the challenges that we face in building this large core stage is to develop world-class tooling using modern manufacturing methods in an affordable way, while maintaining the scheduled first launch in 2017," said Tony Lavoie, manager of the Stages Office at NASA's Marshall Space Flight Center. "This tool set that we've developed for Michoud to build the core stage is a perfect blend of

*See **World's Largest Rocket** on page 7*

Marshall Center Engineers Put 3-D Printed Rocket Parts to the Test

By Tracy McMahan

NASA's Marshall Space Flight Center propulsion engineers recently completed the first test firings of a NASA rocket combustion component manufactured using 3-D additive printing. The tests were conducted in support of acoustic scale model testing for the Space Launch System (SLS) heavy-lift rocket.

"Our Propulsion Systems Department designed the rocket engine injector, our Materials and Processes Lab built it, and our Test Lab conducted the tests," said Chris Singer, director of the Marshall Center Engineering Directorate. "The game changing additive manufacturing process can reduce the time and cost of producing complex parts by an order of magnitude, and taking advantage of an existing test, can make it possible to get the data without running a separate test series. This type of efficient and integrated teamwork is critical for building affordable rockets."

In little more than a month, Marshall engineers built two injectors with a special 3-D printing machine, inspected them and completed four hot-fire tests at extreme temperatures and pressures. Earlier tests in this series used injectors built by traditional methods, so engineers compared the performance of the 3-D printed injectors to that of those built with multiple parts and traditional welds.

Materials engineers made this one-piece rocket engine injector in just 40 hours in a sophisticated 3-D printing machine at Marshall's Advanced Manufacturing Facility. It takes much longer to manufacture the same part by welding multiple parts. (NASA/MSFC/Sandra Greene)

Propulsion engineer Sandra Greene, left, and test engineer Cynthia Sprader recently completed a series of test firings at Marshall Center to gather acoustic data on the engines to be used with SLS. They are holding a 3-D printed injector that was manufactured and readied for the tests on Marshall Center's Test Stand 115, in the background. (NASA/MSFC/Emmett Given)

"We saw no difference in performance," said Sandra Elam Greene, the propulsion engineer who oversaw the tests and inspected the components afterward. "Two separate 3-D printed injectors operated beautifully during four successful, full-duration hot-fire tests. Post-test inspections showed the injectors remained in such excellent condition that we plan to re-use one of them for upcoming tests."

Traditional rocket injectors used on prior tests took six months to fabricate. These injectors had four parts, five welds and detailed machining and cost more than $10,000 each. Marshall materials engineers built the same injector in one piece by sintering Inconel steel powder with a state-of-the-art 3-D printer. After minimal machining and inspection with computer scanning, the part took just three weeks to reach the test stand and cost less than $5,000 to manufacture. Two injectors were completed in time to enable Marshall engineers to test the 3-D printed parts at the conclusion of a series of SLS acoustic tests.

"It took us about 40 hours from start to finish to print each injector using a 3-D printing process called selective laser melting and another couple of weeks to polish and inspect the part," explained Ken Cooper,

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World's Largest Rocket *Continued from page 5*

those requirements and constraints."

Six substantial welding tools will be used to handle assembly of the new cryogenic core stage on SLS. Suppliers worked with NASA and The Boeing Company in Huntsville over the course of a year to design and build the tools. Boeing is the prime contractor for the SLS core stage, including avionics.

The tools include:

- **The Circumferential Dome Weld Tool** will be used to perform circumferential friction stir welds in the production of dome assemblies for the SLS core stage cryogenic tanks.

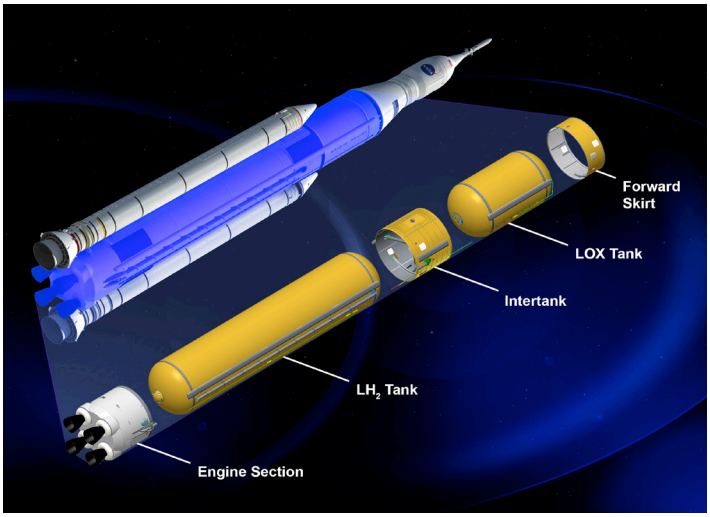
- **The Gore Weld Tool** will perform vertical conventional friction stir welds in the production of gore assemblies for the SLS core stage tanks. Gores are preformed aluminum alloy dome segments that are welded together to make the dome.

- The Circumferential Dome Weld and Gore Weld tools are special tooling for the **Enhanced Robotic Weld Tool** -- used to make dome components for SLS.

- The **Vertical Weld Center** is a friction-stir-weld tool for wet and dry structures on the SLS core stage. It will weld barrel panels together to produce whole barrels for the two pressurized tanks, the Intertank, the Forward Skirt and the Aft Engine Section. It stands about three stories tall and weighs 150 tons.

- The **Segmented Ring Tool** will use a friction-stir-weld process to produce segmented support rings for the SLS core stage. The rings connect and provide stiffness between domes and barrels.

- The **Vertical Assembly Center (VAC)** is where domes, rings and barrels will be joined together to complete the tanks or dry structure assemblies. The tool also will perform nondestructive evaluation on the completed welds. The VAC, measuring 170 feet tall and 78 feet wide, is one of the world's largest welding tools. It is anticipated to be completed in 2014.



Artist rendering of the SLS core stage. (NASA/MSFC/Kevin Obrien)

NASA and Boeing are designing, developing, building and testing the core stage and avionics. The rocket also will use proven hardware from other programs, like the space shuttle -- a significant affordability benefit.

"We are one step closer to building the first core stage in what will hopefully be a long line of rockets to support future NASA missions," said Lavoie.

To see images of the SLS core stage tools, click here.

Davidson, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

Marshall Team Shares NASA Story at Take Our Children to Work Day

NASA astronaut T.J. Creamer, left, a payload operations director in the Marshall Space Flight Center's Payload Operations Integration Center, signs his official NASA portrait for visitors during "Take Our Children to Work Day" June 20. Creamer and Marshall Deputy Director Teresa Vanhooser opened the event, encouraging hundreds of kids in grades 3-12 to explore the center and learn more about Marshall's role in accomplishing NASA's multifaceted mission. (MSFC/Emmett Given)

That's liquid-nitrogen "smoke" issuing from the nostrils of Chris Conn, left, an electronics technician in Marshall's Engineering Directorate. Conn -- who was demonstrating what happens when you eat graham crackers frozen in nitrogen -- was among dozens of Marshall Center volunteers who shared science and engineering principles with young visitors to Building 4316. The Activities Building earned its name throughout the day, as kids assembled straw rockets, NASA picture frames and other space-themed crafts. (MSFC/Emmett Given)

Susan Currie, right, an education program specialist in Marshall's Academic Affairs Office, leads an activity session in the gallery of Building 4205. Participating youths constructed miniature parachutes and Curiosity rover capsules to recreate the Mars Science Laboratory's landing on the Red Planet in 2012. (MSFC/Fred Deaton)

Tim Driskill, left, a flight systems test engineer in the Engineering Directorate's Test Laboratory, leads a tour of the acoustic vibration lab in Building 4619. Visitors learned about engine testing and other research conducted by Marshall engineers in the Flight Robotics Laboratory. They also explored the flat-floor facility, where researchers test new spacecraft docking techniques and remote-controlled robotics. (MSFC/Fred Deaton)

Kristina Hendrix, center, an Analytical Services Inc. employee who serves as an internal communications strategist for the Space Launch System Program Office, helps a young visitor commemorate her day at Marshall with a keepsake photo from the SLS photo kiosk. (MSFC/Emmett Given)

Marshall Space Flight Center Holds LGBT Awareness Activity

NASA's Marshall Space Flight Center's Lesbian, Gay, Bisexual and Transgendered (LGBT) and Friends Professional Collaborative Group held a LGBT awareness activity on June 19.

James Robinson, executive director of Gay, Lesbian, Bisexual and Transgendered (GLBT) Advocacy and Youth Services, Inc., was the guest speaker. His organization is dedicated to engaging in effective advocacy for gay, lesbian, bisexual and transgendered people, specifically committed to ensuring the physical, emotional and spiritual well-being of youth and young adults struggling due to sexual orientation or gender identity issues.

The Marshall LGBT and Friends Professional Collaborative Group strives to ensure a safe, healthy and supportive environment at the center for members of the LGBT community employed as NASA civil servants, contractors or subcontractors. For more information about the group, contact Barry Roberts at barry.c.roberts@nasa.gov or 544-6124.

Willie Love, far left, assistant director of the Office of Diversity & Equal Opportunity, prepares cupcakes and refreshments with, from left, Cindy Coker, Space Systems Department; Barry Roberts, Spacecraft & Vehicle Systems Department; James Robinson, GLBT Advocacy and Youth Services, Inc.; and Jerry Wells, Spacecraft & Vehicle Systems Department. (NASA/MSFC/Ray Downward)

3-D Rocket Parts *Continued from page 6*

a Marshall materials engineer whose team made the injectors. "This allowed the propulsion engineers to take advantage of an existing test series to examine how 3-D printed parts performed compared to traditional parts with the exact same design."

Unlike prior tests with 3-D printed parts, these injectors were directly in the line of fire. The injectors perform a critical combustion function, and thus were exposed to harsh conditions found inside rocket 25 engine generated 1,500 pounds of thrust by burning liquid oxygen and gaseous hydrogen at 5,800 F under pressures up to 780 pounds per square inch gauge.

"We plan to continue manufacturing 3-D printed parts and testing them to see how they hold up," said Singer. "Marshall Engineering is testing innovative technologies with an eye toward applying them to NASA exploration missions. In today's highly resource-constrained and schedule-critical environment, this capability enables flexibility in the process of design, build, test, learn and improve and opens up an affordable way for us to explore entirely new possibilities for the Space Launch System and other projects."

Watch a video of the hot fire testing of 3-D printed part: http://av.ndc.nasa.gov/content/play.php?video=Test1 and http://av.ndc.nasa.gov/content/play.php?video=Test2.

McMahan is a public affairs officer in the Office of Strategic Analysis & Communications.

Obituaries

Iva C. "Buddy" Yates, 82, of Laurel, Miss., died June 15. He retired from the Marshall Center in 1995 as an aerospace engineer. He is survived by his wife, Betty Yates.