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# Spaceport News

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

NASA/Tim Jacobs

A new 12-inch water main is being installed as part of a water/wastewater revitalizing plan at Kennedy Space Center on Jan. 11. Work on Phase 4 will continue until the fall of 2014.

## Revitalization project upgrades water, pipes

***By Frank Ochoa-Gonzales***
*Spaceport News*

Water has played a prominent role in mission success during the 50 years Kennedy Space Center has been around.

Released during launches to dampen the acoustic sound levels, it's been there flowing when we needed it most.

A majority of the components of the center's water and wastewater system are now 50 years old, too, thus exceeding their designed life expectancy.

In 2004, engineers began working on a plan to improve Kennedy's water quality, replace aging system pipes and lift stations, and reduce excessive water flushing.

"With aging pipes come failures such as main breaks, sewage spills and poor water quality," said Kevin Miller, project manager with NASA's Construction of Facilities Division. "These failures are becoming progressively more serious and costly and cause great disruptions to the center's institutional

To **WATER**, Page 2

## Work officially begins on Test, Operations Support Contract

***By Bob Granath***
*Spaceport News*

The same day SpaceX 2 lifted off on the second commercial resupply mission to the International Space Station, NASA's Test and Operations Support Contract (TOSC) was launched by Jacobs Technology Inc. The agreement will provide overall management and implementation of ground systems capabilities, flight hardware processing and launch operations at Kennedy Space Center.

TOSC was awarded to Jacobs in late December. Following a two-month phase-in period that started Jan. 2, the work under the contract officially began March 1.

Working with the Jacobs team are subcontractors Engineering Research and Consulting Inc. (ERC), and Aerodyne Industries LLC, providing support for the International Space Station, Ground Systems Development and Operations (GSDO), Space Launch System (SLS), Orion multi-purpose crew vehicle, and Launch Services programs.

"The transition has been exceptionally smooth," said Pete Nickolenko, deputy director of the Ground Processing Directorate at Kennedy. "Bringing the Jacobs team on board for operations and processing services has been seamless."

The smooth nature of the phase-in was evident as members of the Jacobs team supported the launch of the SpaceX Falcon 9 rocket on March 1, which delivered the Dragon capsule filled with experiments and other supplies to the International Space Station.

TOSC General Manager Andy Allen agreed that the Jacobs team was ready to go.

"The TOSC phase-in went very well, and we were very pleased with our readiness to begin the contract," said Allen, a former NASA astronaut. "The support from NASA and USA (United Space Alliance) was extraordinary and helped the phase-in to be that much more successful."

Allen noted that the TOSC team assembled by Jacobs is highly-skilled, and he is confident it can

To **TOSC**, Page 3

## Inside this issue...

## *Celebrating Women's Heritage Month*

# Ride's flight inspired Burnett's devoted path

***By Anna Heiney***
*Spaceport News*


*NASA/Dimitri Gerondidakis*

Josie Burnett, director of International Space Station Processing and Ground Research at the Kennedy Space Center, provided an overview of current and future activities at the Florida spaceport during the annual Community Leaders Briefing on Feb. 21. At the age of 10, Burnett wrote to NASA asking for advice on what she'd need to do to become an astronaut.

She was watching on June 18, 1983, when mission specialist Sally K. Ride blasted through the glass ceiling and into orbit aboard space shuttle Challenger on the STS-7 mission.

"I remember it because I wanted it to be me," said Josie Burnett, who today serves as director of International Space Station Ground Processing and Research at Kennedy Space Center.

Burnett grew up devoted to the idea of a career with the space program. At the age of 10, she wrote to NASA asking for advice on what she'd need to do to become an astronaut. The agency replied: become a test pilot or an aerospace engineer.

This was one of the reasons Ride's flight was so significant to Burnett. Unlike so many astronauts who'd come before, Ride was a physicist, not a military pilot.

Rather than take the military path without knowing whether she'd be able to amass enough flight hours to qualify, Burnett instead earned a degree in aerospace engineering from the University of Florida.

When she came to work for NASA in 1987, she immediately saw the benefits of the agency's dedication to recruiting diversity.

"NASA was already ahead of the game in terms of providing opportunities for everybody," said Burnett, who hired into a group evenly split between men and women.

"Once you get hired, it's what you make of it," she added. "Each individual, male or female, has their own individual challenges, barriers you have to break down in order to be who you are."

Burnett's career trajectory has taken her through several organizations at Kennedy, where she's supported the Spacelab modules, space shuttle payloads, International Space Station assembly, and now, the transition from assembly to station utilization in the post-shuttle era. Today, the station organization at Kennedy is focused on the processing and housing of most of the spare station hardware still on Earth, processing experiments that fly on the SpaceX Dragon capsules, and developing new flight hardware for plant research.

Despite the challenges of operating with a leaner team and smaller budget through a period of constant change, the entire team has pulled together to ensure success.

"We wouldn't be where we are today if not for the contributions made by every NASA employee, no matter what gender you are or what cultural background you have," Burnett said. She pointed out that the space station itself exemplifies the value of cooperation.

"Some of us take for granted the value of diversity," she said, "but without that balance, I don't think we could do those hard things we want to do."

From **WATER**, Page 1

and programmatic operations."

So they came up with the Revitalize KSC Water and Wastewater Systems Plan.

Many things have changed since the initial construction of Kennedy's water distribution and sewer collection systems, including stricter water-quality standards, increased fire-suppression requirements, and numerous facility and program changes. These factors, combined with system components that had exceeded their designed life expectancy, necessitated centerwide changes.

"These planned projects are significantly improving our water quality, system reliability, and our systems capacity and flexibility, all while reducing maintenance costs," Miller said. "It had been a long time coming."

The project has five planned phases.

Phase 1 ran from August 2007 to September 2008 with a $1.9 million construction contract value. This phase included numerous studies to identify issues and provide solutions to repair water and waste-water infrastructure across Kennedy. Construction included repairs to the W1 pump station, the main pump station for Kennedy; backflow preventers; and water meters.

Phase 2, which was completed from August 2010 to October 2011, had a $1.5 million construction contract value. This phase included replacement water main valves, a new water main on A Avenue, installation of water meters, replacement of individual facility service water lines, installation of a new water quality analyzer, and repairs and upgrades to four lift stations.

Phase 3, which is 85 percent finished, started in September 2011 and has a $9.1 million construction contract value. It is targeted for completion in spring 2013. This phase began as a major revitalization effort to replace degraded pipelines with 12.8 miles of replacement water mains, 3.2 miles of repairs to gravity sewer mains, and repairs and upgrades to nine sewage lift stations. This included the deconstruction of a water tower in the Launch Complex 39 area.

Phase 4, which is 15 percent completed and has a $22.3 million construction contract value, was started in October 2012. It is scheduled to be completed in fall 2014. This phase builds upon previous phases and is the largest in scope with 22.5 miles of replacement water main, 4.5 miles of replacement sewer force main, and repairs and upgrades to 58 sewage lift stations.

Phase 5, to be designed later this year, is scheduled to run from summer 2015 to fall 2016 and will be funded for construction in Fiscal Year 2015. This is the last phase and includes additional water main replacement, replacement of water and sewer infrastructure at KARS Park, and a replacement pump station.

"The water systems proposed for replacement are a critical component of the KSC fire system as well," Miller said, "and vital to mission readiness and success."

*NASA image*

Kennedy Space Center Director Bob Cabana, at left, talks to Attorney General Pam Bondi about the center's accomplishments at the Capitol in Tallahassee during Florida Space Day 2013 meetings March 5 and 6.

# Florida Space Day highlights center accomplishments

***By Linda Herridge***
*Spaceport News*

Kennedy Space Center Director Bob Cabana met with Florida legislators at the Capitol in Tallahassee and spoke to students at Elizabeth Cobb Middle School during Florida Space Day activities March 5 and 6.

Cabana met with Florida Lt. Governor Jennifer Carroll, Attorney General Pam Bondi, Agricultural Commissioner Adam Putnam and several state legislators to highlight Kennedy's accomplishments during the past year and what's ahead for 2013.

"Space Day is a great opportunity to update our state representatives about Kennedy Space Center's progress toward becoming a multiuser complex," Cabana said.

Bob Crippen, former astronaut and Kennedy director, made appearances throughout the day and spoke to legislators about how important space is to the Florida economy.

"It is important for the state government to continue their support of space exploration," Crippen said.

The middle school's 850 students participated in hands-on workshops coordinated by Kennedy's Education Office. They built a model of a planetary lander that will protect astronauts, learned about different water filtration products and viewed a main engine demonstration to learn about engine propulsion.

"Space Day is a great time for NASA to reach out to the Tallahassee community, and where better to make our presence known than at a middle school?" said Hortense Diggs, division chief of Kennedy's Education Office. "These students may become the NASA workforce of the future, so it is vital that we get them excited and engage them in space-related activities today."

Kennedy's Display Management Team provided several exhibits in the Capitol rotunda that were viewed by legislators and the general public. The displays highlighted the past, present and future of the center, and recent accomplishments of the Commercial Crew (CCP), Grounds Systems Development and Operations and the Launch Services programs.

Also on display were models of CCP partners' spacecraft: The Boeing Company's CST-100, Sierra Nevada Corp.'s Dream Chaser, and Space Exploration Technologies' (SpaceX) Falcon 9, as well as NASA's Space Launch System.

Don White Jr., the chairman of Florida Space Day 2013, said Florida is home to nearly 450 aerospace companies that employ about 31,000 professionals.

"This year's event was critical, as the state's space industry looks to expand and diversify its space-related and non-traditional opportunities," White said.

White said Florida Space Day is an opportunity to educate and bring top-of-mind awareness to Florida legislators on the significance of the aerospace industry and its impact on Florida's economy.

From **TOSC**, Page 1

meet any challenge.

"TOSC had about 5,000 applicants for approximately 500 positions," he said. "We conducted over 2,000 interviews and making the final selection was very difficult as they were so very qualified. We are staffed at the desired level and the workforce is ready."

Led by director Scott Kerr and Nickolenko, Ground Processing is responsible for providing spaceflight hardware preparation activities, launch operations, ground systems operations and maintenance, as well as logistics support to NASA, other government agencies and commercial customers at the Florida spaceport.

"The Jacobs-TOSC team will provide processing of launch vehicles, spacecraft and space station orbital replacement units, as well as logistics and support for the upcoming GSDO preliminary design review, among other operations and initiatives," Nickolenko said.

The contract is another step forward as Kennedy transitions to a 21st-century launch facility with multiple users. The infrastructure taking shape is designed to host many kinds of spacecraft and rockets, sending people on America's future voyages in space.

Allen pointed to some of the start-up tasks his TOSC team will be working in the near future.

"The merging of contracts and the legacy systems will be our immediate challenge as we develop a single approach to performing on this contract," he said. "Transitioning the development of the SLS ground support systems from design to operations will present a challenge as well."

Nickolenko is confident his team can meet varied challenges ahead.

"This contract positions Kennedy to be flexible as we move forward," Nickolenko said. "It will not only support NASA's primary missions, but emerging commercial customers. TOSC is structured so we can add additional work as it becomes necessary."

As new programs come on line, Allen says the TOSC team will be ready to expand the scope of work as new tasks are added to the contract.

"We will hopefully add on more," he said, "as the NASA SLS program begins to bring hardware to Kennedy for processing and launch."

# Scenes Around Kennedy Space Center

NASA/Frank Ochoa-Gonzales

Harriet Harris shares a moment with Brig. Gen. Anthony Cotton, commander of the 45th Space Wing and director of the Eastern Range at Patrick Air Force Base, during the Black Employee Strategy Team's (BEST) 2013 African-American History Month Luncheon on Feb. 28. Johnson is the sister of Evelyn Johnson, a founding member of BEST.

## Brig. Gen. Cotton shares 'common ground' with Kennedy workers at BEST luncheon

The Kennedy Space Center Black Employee Strategy Team (BEST) hosted the annual African-American History Month luncheon at the Space Station Processing Facility's Conference Center on Feb. 28. Brig. Gen. Anthony Cotton, commander of the 45th Space Wing, shared stories about his past and his dreams of the future. Two of the three 2013 recipients of the Evelyn Johnson Scholarship were in attendence and recognized. The scholarship is given in memory of Johnson, a founding member of BEST and former deputy director of the KSC Equal Opportunity Office.

NASA/Frankie Martin

Dionne Jackson sang an inspired version of "The Star-Spangled Banner" to open the ceremonies.

NASA/Frank Ochoa-Gonzales

Aliyah Jenkins, left, and Maurisa Orona are two of three 2013 Evelyn Johnson Scholarship winners.

NASA/Jim Grossmann

A worker guides a parabolic telemetry antenna and tracker camera to the roof of the Launch Control Center (LCC) in Launch Complex 39 at Kennedy Space Center with the help of a crane. This antenna and camera system is the first of three that will be installed on the LCC roof for the Radio Frequency and Telemetry Station (RFTS), which will be used to monitor radio frequency communications from a launch vehicle at Launch Pad 39A or 39B as well as provide radio frequency relay for a launch vehicle in the Vehicle Assembly Building. The RFTS replaces the shuttle-era communications and tracking labs at Kennedy. The modern RFTS checkout station is designed primarily to support NASA's Space Launch System and Orion spacecraft, but can support multi-user radio frequency tests as the space center transitions to support a variety of rockets and spacecraft.

NASA/Kim Shiflett

Roy Tharpe celebrates his service to the space program with family, friends and co-workers at Headquarters on Feb. 22. Tharpe began working for NASA at Kennedy in 1963 as a data analyst on Project Gemini.

# Workers practice stacking replica escape rocket

***By Steven Siceloff***
*Spaceport News*

Crane operators, technicians and engineers practiced lifting and stacking techniques in February as they moved a 6-ton replica escape rocket called the LAS, for Launch Abort System, from a trailer to the top of a mock-up Orion capsule.

Though stacking the real thing for a Space Launch System mission is still a few years off, engineers said performing the task now, using the same procedures and demands that will accompany the actual assembly, helps them anticipate difficulties ahead of time.

The practice also keeps the crane operators proficient in handling spacecraft components that must be moved gingerly and placed precisely. The exercise took place inside the Vehicle Assembly Building (VAB) at Kennedy Space Center using the same equipment and operators that stacked space shuttles for launch.

"The breakover, taking the LAS from horizontal to vertical, is not as easy as it sometimes seems, but the VAB guys are exceptional. They are really good at what they do so they really didn't have a problem," said Douglas Lenhardt, who is overseeing the Orion mock-up and operations planning for the Ground Systems Development and Operations Program.

During missions, the LAS will be ready to ignite its solid-fueled engines and lift the Orion and its crew away from disaster in the unlikely event that the booster fails during the first part of launch. Its design is similar to that used during Apollo launches, though the LAS is larger than the escape rocket used previously. A test flight in 2010 saw the LAS produce 500,000 pounds of thrust, about the same as the Titan II rockets that launched Gemini spacecraft into orbit.

As powerful as the thrust is for an escape rocket, the LAS's power is a fraction of the overall thrust the Space Launch System is designed to produce to lift Orion into orbit and then propel it to deep space.

The LAS stacking topped off a mock-up Orion and service module that has been standing at the north end of the transfer aisle in the VAB for several months. It will remain there so engineers and designers can continue to refine their plans for the spacecraft as it evolves from a concept that exists only on a computer screen to a spacecraft carrying humans into deep space.

"The number one thing people say about real hardware is, the computer-aided design (CAD) model doesn't do it justice," Lenhardt said. "Things seem to almost always work on a CAD mode. Real-life, things don't always work perfectly and that's why it really does help having a physical model."

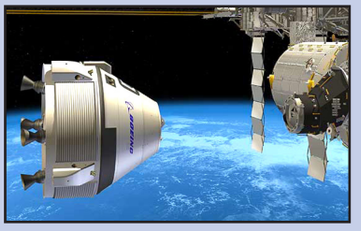
*NASA/Charisse Nahser*

A mock-up of the Launch Abort System (LAS) is lifted off a trailer inside the Vehicle Assembly Building at Kennedy Space Center on Feb. 25 so it can be positioned atop an Orion capsule during test stacking operations. The Orion spacecraft is being designed to carry astronauts on missions beyond Earth orbit. It will have the LAS during the first part of launch in case an emergency develops that requires the spacecraft be pulled away from the rocket to save the crew. NASA's Ground Systems Development and Operations Program performed the test operations.

## *Spotlight on Commercial Crew Development*

### Blue Origin Biconic Space Vehicle

NASA and Blue Origin signed an agreement to extend their Commercial Crew Development Round 2 (CCDev2) partnership in an unfunded capacity. Between now and mid-2014, the company will continue to advance subsystems for its biconic-shaped spacecraft. The company also will test fire its liquid-oxygen and liquid-hydrogen fueled BE-3 engines at its West Texas Launch Site. This CCDev2 extension will allow NASA to provide expert feedback to Blue Origin as the company works through additional milestones.



### Boeing CST-100/Atlas V

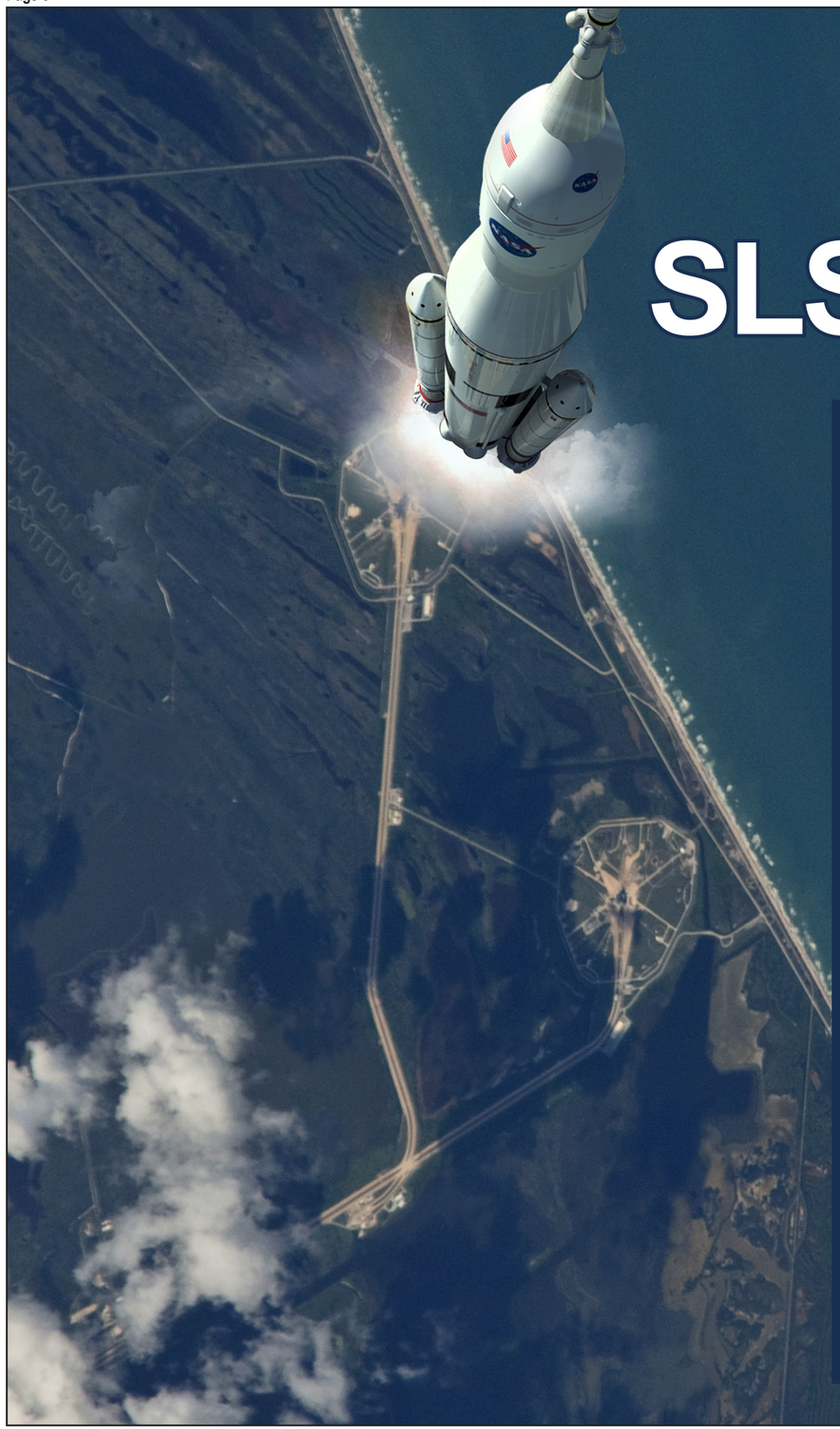
Boeing has focused on its Launch Vehicle Adapter design as the company closes in on plans for the component that will connect the CST-100 capsule to the United Launch Alliance (ULA) Atlas V rocket. NASA's Partner Integration Team, also called a PIT crew, worked with Boeing to complete a preliminary design review for the adapter. Boeing also discussed its prelaunch sequence plans with NASA and ULA. Earlier this year, Boeing worked with NASA to establish what will be needed to communicate with the spacecraft and recover it when it returns from a mission.

### Sierra Nevada Corp. Dream Chaser/Atlas V

Sierra Nevada Corp. Space Systems is working with NASA to develop two flight campaigns, a crewed suborbital and an uncrewed orbital, as the company prepares to prove its Dream Chaser flight test vehicle can perform as planned. It selected Lockheed Martin to build future Dream Chaser composite structures at NASA's Michoud Assembly Facility. An Integrated Systems Safety Analysis Review earlier this year gave NASA insight into how the company plans to mitigate and reduce hazards on the integrated spacecraft and United Launch Alliance Atlas V rocket.

### SpaceX Dragon/Falcon 9

Throughout the next several weeks, SpaceX will talk with NASA engineers about the systems necessary to support crewed flights in the company's Dragon capsule, from biomedical and life support to software and processes with which a crew would need to become familiar in order to command a Dragon mission. The SpaceX team also is gearing up to host a number of sessions to talk with NASA about how the company plans to meet the agency's safety and performance requirements for crewed Dragon missions to the International Space Station.



# Tri-Program shows off SLS, Orion, GSDO teamwork

***By Steven Siceloff***
*Spaceport News*

The first spacecraft NASA has designed to fly astronauts beyond Earth's orbit since the Apollo era is well on its way to making a flight test next year, agency officials said Feb. 27. The mission is planned for launch in September 2014, and will see an Orion capsule orbit Earth without a crew and return through the atmosphere at speeds unseen since astronauts last returned from the moon in 1972.

"It's a key element of our overall plan to get humans beyond Earth orbit as quickly as we can," said Dan Dumbacher, deputy associate administrator for NASA's Exploration Systems Development Division.

Exploration Flight Test (EFT)-1, will be the first chance engineers get to test Orion's design in space. Flying atop a United Launch Alliance Delta IV rocket, the spacecraft will be pressurized as it would be if astronauts were aboard. It will orbit the Earth twice on a track that will take it more than 3,600 miles above us, about 15 times higher than the International Space Station.

From that height, Orion will be steered to a re-entry at speeds of about 20,000 mph, slamming into the atmosphere to test whether the heat shield will protect the spacecraft adequately.

"It allows us to stress the heat shield in conditions that are very close to what we will see coming back from a region around the moon," said Mark Geyer, Orion program manager. "This is going to help us make our heat shield lighter, safer and more reliable."

Launching from Cape Canaveral Air Force Station, the spacecraft will carry scores of instruments. Even the heat shield will have instruments to measure temperature and plasma flow around the spacecraft as it endures the searing conditions of high-speed re-entry.

Engineers will use the readings to update computer models and refine designs for the spacecraft, ground support equipment and the in-development Space Launch System rocket. NASA also will provide the data to the agency's commercial partners developing their own spacecraft.

Orion will land under parachutes in the Pacific Ocean where recovery teams from Kennedy Space Center and the Department of Defense will retrieve it and return it to Florida.

Just as the mission will help spacecraft designers, the recovery will show those on the ground what to expect when they begin retrieving crews after long missions into deep space, said Pepper Phillips, director of the Ground Systems Development and Operations Program based at Kennedy.

"The teams are exercising some static tests now, but we're going to be ready with this full-up active test of a live spacecraft," Phillips told reporters who had gathered in the Young-Crippen Firing Room at Kennedy for the update Feb. 27.

The firing room, which has been refurbished and extensively modified since last hosting a space shuttle launch, will give engineers direct links to the Orion after it is powered up later this year. Launch controllers will follow the mission from the same firing room, as well.

NASA designed Orion as a versatile spacecraft able to handle the hardships of flying safely far beyond Earth's atmosphere to take astronauts to distant destinations such as an asteroid and Mars. Starting in 2017, Orion spacecraft will be paired with the agency's Space Launch System (SLS), a massive rocket in development more powerful than the Saturn V that propelled astronauts to the moon.

Although EFT-1 will focus largely on testing the Orion spacecraft, it also will aid the teams designing and building the SLS, said Todd May, program manager for the new booster.

"There are a lot of things about this mission that helps SLS," May said. "A lot of this data is data we're going to use to understand the structural properties, the aeroloading, the guidance navigation and control that we feed back into our calculations."

The SLS team, based at Marshall Space Flight Center in Huntsville, Ala., designed and built an adapter ring for this mission that will connect Orion's broad base with the much narrower Delta IV second stage.

While the Orion spacecraft takes shape inside the Operations and Checkout Building at Kennedy, the heat shield's skin and skeleton have been finished. The heat-resistant coating will be applied next month and the all-important component will be shipped to Kennedy in July for attachment to the spacecraft.

NASA has designed the mission to evaluate how the spaceship behaves in 10 of the 16 highest risk areas for a crew. Avionics systems, software and the myriad other elements that go into a spacecraft are expected to get a rigorous workout. Those elements are making their way into the spacecraft in a careful procession as Lockheed Martin builds up Orion into a working spacecraft.

"We all have these great (computer) models but when you fly in the real environment, does it behave as you expect?" Geyer asked.

The endeavor will begin a series of flight tests for the Orion and Space Launch System programs as the agency moves toward launching astronauts into space in 2021. Orion is scheduled to fly a second test mission in 2017 aboard the first Space Launch System booster.

Along the way, engineers also will conduct smaller-scale flight tests to evaluate the performance of specific systems such as the escape rocket designed to pull a crew out of harm's way in the event of an emergency during launch and ascent.

The progression from concept drawings to working with mockups and replicas to building the actual spacecraft reinvigorates the teams, the officials said.

"I think it helps keep the team's morale up and you want to see a steady beat of successes as you move forward," May said.

"Now we're actually doing it," Geyer said. "It shows you that we're putting the expertise into actually making it happen."

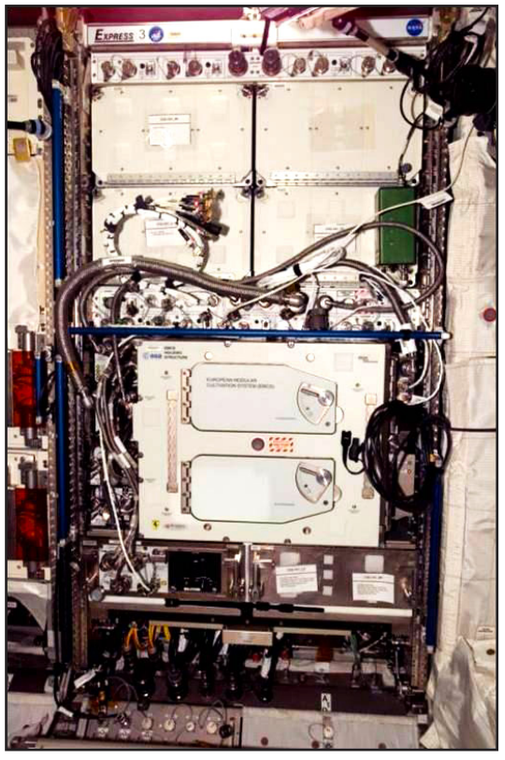
# Engineers design space station plant habitat

*By Bob Granath*
*Spaceport News*

Some of the research on the International Space Station focuses on meeting the needs of long-term spaceflight to destinations such as asteroids or Mars. A group of engineers at Kennedy Space Center is developing a plant habitat with a large growth chamber to learn the effects of long-duration microgravity exposure to plants in space.

Through most of Kennedy's history, the space center has focused on receiving, processing and launching vehicles developed at other centers. Design projects such as the plant habitat give employees an opportunity to further use their extensive knowledge base in preparing flight hardware.

"This is the first Kennedy-led space station payload of this magnitude," said Bryan Onate, Plant Habitat Project manager in the International Space Station (ISS) Ground Processing and Research Directorate. "We're using in-house expertise to develop the plant habitat to go on an Expedite the Processing of Experiments to Space Station (EXPRESS) rack in the station's Destiny laboratory. It will provide a large, enclosed, environmentally controlled chamber designed to support commercial and fundamental plant research aboard the space station."



NASA

NASA is using in-house expertise to develop this plant habitat in an Expedite the Processing of Experiments to Space Station (EXPRESS) rack in the International Space Station's Destiny laboratory. The plant habitat will provide a large, enclosed, environmentally controlled chamber designed to support commercial and fundamental plant research aboard the space station.

The plant habitat is configured as a payload that will be mounted on a standard EXPRESS rack. The multipurpose payload rack system stores and supports research and science experiments across many disciplines by providing structural interfaces, power, data, cooling, water and other needs to operate science payloads in orbit.

The compact facility is about 21 inches high, 36 inches wide and 24 inches deep and would use about 735 watts of power.

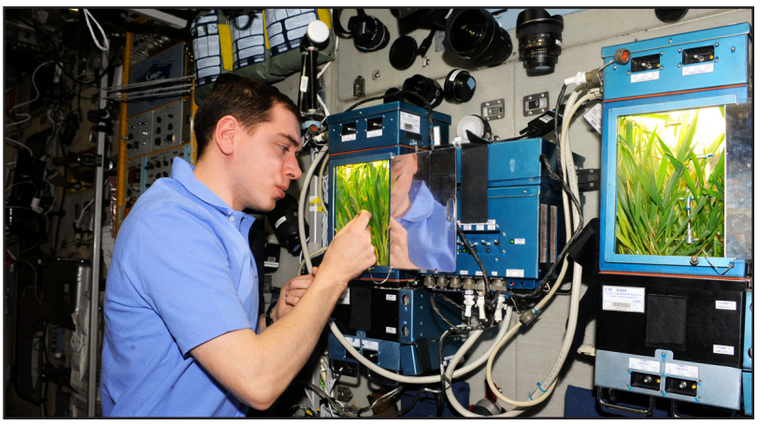
"NASA is conducting plant research aboard the space station because during future long-duration missions, life in space may depend on it," Onate said.

As NASA plans missions beyond low-Earth orbit, relying on plant growth aboard a spacecraft will play an important role.

"The ability of plants to provide high-quality science within a tightly closed system, a source of food and recycle carbon dioxide into breathable oxygen may prove crucial for astronauts and add to the body of knowledge as they live in space for months at a time," he said.

Onate explained that most of the experiments conducted on the space station are developed by principal investigators from universities or other research institutions.

"The plant habitat is an effort to attract a broader audience of principal investigators that need a large growth area for a long duration," he said. "In order to expedite this capability on the space station, we have contracted with Orbital Technologies Corp. to help us design, fabricate and certify the plant habitat for flight."



NASA

Some of the research on the International Space Station already is focusing on meeting the needs of long-term spaceflights beyond low-Earth orbit. During Expedition 29, Russian cosmonaut Sergei Volkov checks the progress of a new growth experiment aboard the space station on Sept. 22, 2011.

Based in Madison, Wis., Orbital Technologies Corp., better known as ORBITEC, is a leading subsystems integrator and high-technology development company.

The plant habitat's design includes the ability to control temperature, humidity, carbon dioxide levels and lighting.

"Lighting is an important part of plant growth," Onate said. "We're using LEDs in this payload. Our experience shows that the LEDs work well in plant growth experiments in our labs here at Kennedy."

Within the plant habitat there is a tray called a science carrier that will hold various types of plants. The science carrier is a removable and reconfigurable tray that will provide the primary structural support and final water delivery to the root-zone for in-orbit plant growth experimentation.

The science carrier consists of a structural element, a water delivery mechanism, and a standard interface plate that will provide instrumentation support as part of the basic plant habitat capabilities. The carrier also will provide more instrumentation interfaces for additional, experiment-specific measurement data required to allow investigators to extend the habitat's basic capabilities.

"Our design will allow principal investigators to modify the carriers depending on the type of plants they want to grow and the kind of experiments they have in mind," Onate said.

Plant habitat investigations can use the microgravity of space and can run 30, 60 or 90 days depending on the nature of the research.

"These trays will have a system of tubes allowing astronauts conducting the experiment to inject water and other plant nutrients into the media supporting plant growth," Onate said.

The next step for the plant habitat is a preliminary design review in April. During the review, engineers will report on how the project is progressing to ensure the design meets system requirements within acceptable risk and falls within schedule and budget constraints.

"One of the design challenges we're dealing with now is the physical size and power requirements for the plant habitat," Onate said. "Weight, volume and maximizing valuable space station resources are always an important consideration for any payload designed for spaceflight.

"Launch of the Kennedy-designed plant habitat will likely go up on a SpaceX Dragon spacecraft," Onate said. "It is targeted for launch in December 2015."

## KENNEDY TEAM PREPARES, PACKAGES RESEARCH FOR ISS

# Canisters aid in space plant-growth study

***By Bob Granath***
*Spaceport News*

On March 1, a Space Exploration Technologies Corp. Dragon capsule launched aboard a Falcon 9 rocket from the Cape Canaveral Air Force Station on the second Commercial Resupply Services flight to the International Space Station. Two Biological Research In Canisters (BRIC) investigations, BRIC-17-1 and BRIC-17-2, were aboard.

The BRIC series canisters consist of a compact storage system for housing experiments first used in studies during the U.S. Microgravity Payload mission aboard space shuttle Columbia's STS-87 mission in November 1997. BRIC flew on three subsequent shuttle flights, including STS-135 in July 2011.

"BRIC lends itself to the 'fast-track' model in which a payload can be ready to fly in six to eight months," said Jose Camacho, BRIC project manager at Kennedy Space Center. "It normally takes a much longer period of time to prepare an experiment for flight."

The BRIC experiments flying on the mission consist of work submitted by principal investigators Anna-Lisa Paul, Ph.D., professor of molecular genetics at the University of Florida, and Simon Gilroy, Ph.D., a professor of botany at the University of Wisconsin-Madison.

*NASA/Jim Grossmann*

Dr. Howard Levine, chief scientist in NASA's International Space Station Ground Processing and Research Directorate, watches as Michele Koralewicz of QinetiQ North America assembles a Biological Research in Canisters (BRIC) experiment package Nov. 20.

Both investigators were selected in response to the NASA Research Announcement, “Research Opportunities in Space Biology.”

Paul's study will investigate how "undifferentiated cells," lacking the usual specialized structures traditionally required for response to gravity, react differently in space. An undifferentiated cell is an immature or undeveloped cell that has not yet acquired a special structure and function. The experiment will use cells from Arabidopsis, small flowering plants related to cabbage and mustard, to see if they reveal any unique gene development patterns in response to the space environment.

Gilroy's investigation will examine how spaceflight affects gene development in Arabidopsis seeds under low-oxygen conditions, or hypoxia. Root-zone hypoxia is thought to develop in spaceflight as weightlessness leads to a reduction in the buoyancy-driven convection that usually aids in gas exchange around organisms. This in turn leads to the development of oxygen-limiting conditions with adverse effects on plant vigor and productivity.

The investigations also will contribute to an understanding of how environmental stimuli interact to affect plant development in a weightless environment. In addition, the plant analyses will test the potential for using defined mutations to tailor plants to thrive in space. Ultimately, these experiments will help provide a source of food during long-term spaceflight to destinations such as asteroids or Mars.

The BRIC canisters in which the experiments will travel are seven inches by four inches by four inches and hold five or six Petri dish fixation units. Each principal investigator will process four of the fixation units.

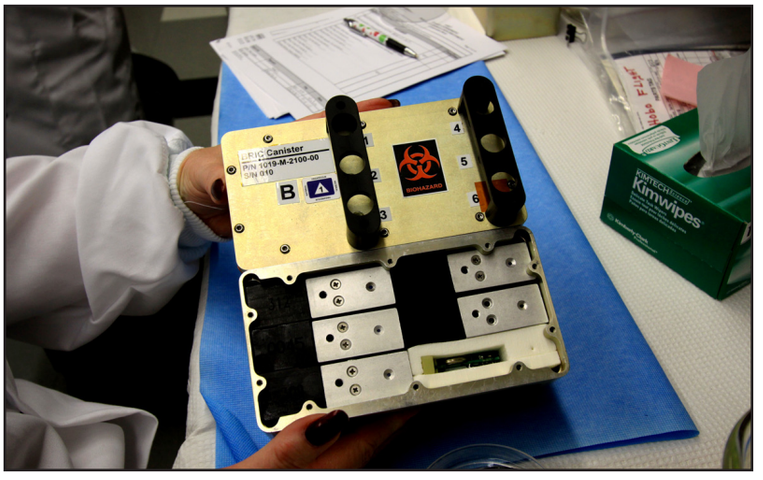
Once aboard the orbiting laboratory, the experiments, packaged at 39 degrees Fahrenheit, will activate and begin to grow upon exposure to the ambient temperature inside the space station. The investigations will run between seven and 10 days.

The seedling and cell growth experiment will be stopped, or “fixed” in time, using a chemical called RNALater administered by a crew member using an actuator tool developed at Kennedy. "Fixing" the specimens stops all biological activity and prevents corruption of the microgravity effects when the experiment is exposed to gravity upon landing. The experiments are then frozen in the space station's Minus Eighty Degree Laboratory Freezer (MELFI) and stored until they are ready to be placed back into the Dragon capsule for the return trip to Earth.

The same operations performed on the space station also will be performed in ground control units, stored in an environmental chamber at the Space Station Processing Facility at Kennedy.

"This will give the principal investigators the ability to study identical subjects and compare what happened in space to what took place in the gravity of Earth," Camacho said.

"The plan is to have the experiments back in the hands of the principal investigators approximately 72 to 96 hours after Dragon splashes down in the Pacific Ocean," said Camacho. "As we look ahead to longer-duration spaceflights, knowing how to grow plants will be crucial for food, as well as air and water purification."




*NASA/Jim Grossmann*

A Biological Research in Canisters (BRIC) experiment package with five Petri dish fixation units is prepared for flight Nov. 20. The units each contain a Petri dish with the biological sample to fly aboard a Space Exploration Technologies Dragon capsule on the second Commercial Resupply Services flight to the International Space Station.


*CLICK ON PHOTO* *NASA/George Roberts*

A Space Exploration Technologies Falcon 9 rocket lifts off Space Launch Complex 40 on Cape Canaveral Air Force Station on March 1. For more on the mission, click on the photo.

# ISS may provide clues in Alzheimer's fight

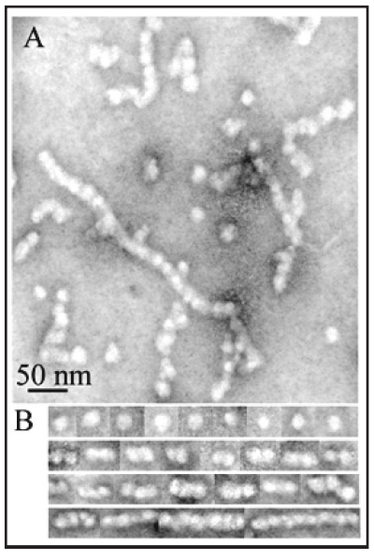
*By Steven Siceloff*
*Spaceport News*

Some of the core beliefs about what causes Alzheimer's and Parkinson's disease may be wrong, and flying an experiment on the International Space Station could provide the best way to show it, say researchers at Kennedy Space Center.

Scientists at Kennedy, working with a pioneering researcher at the Florida Institute of Technology (FIT), want to send a set of proteins to the space station where the material would be free to collect together into large, complex structures without gravity tearing them apart.

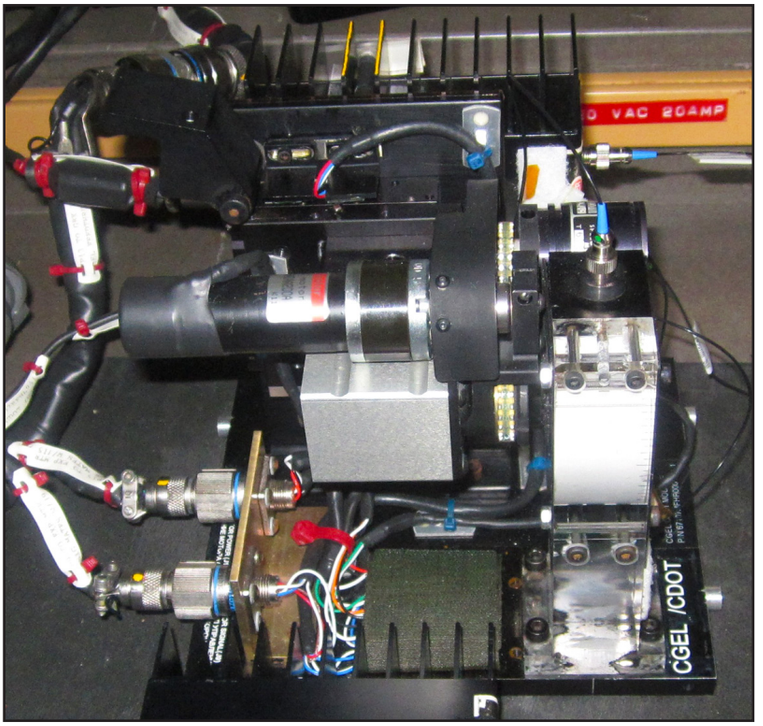
Their thought is that Alzheimer's and other diseases, including those that develop from head injuries in sports, occur not because normal proteins become corrupted, but because with aging or after repeated concussions, changes occur in the environment within the brain that cause certain proteins to cling together in ever-larger threads that choke off brain cells, slowly depriving a person of memories and brain functions.

David Tipton, chief medical officer at Kennedy, said current theories about the cause of Alzheimer's and similar diseases perhaps misidentify the problem. He is working with Dan Woodard, an aerospace physician with InoMedic Health Applications at Kennedy, and Shaohua Xu, a professor at FIT who proposed the theory while working at the Space Life Sciences Lab at Kennedy.




NASA

Protein molecules aggregate to form colloidal spheres which self-assemble to form filaments.




NASA

The Colloidal Disorder-Order Transition (CDOT) flight hardware unit developed by Glenn Research Center successfully has flown aboard STS- 73 with the United States Microgravity Lab (USML2), the Russian Mir and STS-95 in support of colloidal aggregation studies in space. The unit also was used in the lab to study the kinetics of protein aggregation.

"We believe it may be a colloidal chemical process rather than a biochemical process," Tipton said. "NASA has a lot of background and experience in colloidal chemistry and crystal chemistry so this is a perfect opportunity for NASA's experience, and knowledge and equipment and capabilities. It can be used to evaluate whether this theory could indeed cause the kinds of changes in cells associated with these diseases and thereby allow a different approach by the pharmaceutical and medical industries to potentially come up with new treatments for these diseases."

NASA has an extensive history of studying crystal formation and processes similar to the protein development the researchers propose. Astronauts operated crystal growing experiments during space shuttle missions and during flights to the Russian Mir space station.

"We've been able to see almost at the atomic level how these individual protein molecules join together," said Woodard. "We can see that it is not consistent with normal biochemistry. But if we look outside the field of biochemistry and look at another field called colloidal chemistry, we actually find very similar processes, except that they aren't usually associated with living organisms."

The research can only go so far on Earth because gravity keeps the protein structures from growing beyond a certain size in the laboratory before they collapse of their own weight.

"It appears we might have the technology and experience to answer a few questions here," Tipton said.

The scientists want to send a container holding the proteins to the International Space Station to find out if protein strands grow as the researchers expect. If their theory holds, the proteins should clump together in larger structures than are seen in Earth's normal gravity.

The team has been working with scientists at NASA's Glenn Research Center in Ohio who conducted several prior experiments that examined colloidal processes in space.

"In zero-gravity, these colloidal interactions can occur much faster because gravity isn't pulling the colloid out of suspension," Tipton said. "In Alzheimer's, it takes 20, 30, 40 years. If you wait 20, 30 or 40 years, your research isn't going to move very fast."

As the particles accumulate, they even may take on a different state in the same way that the particles that make up paint behave one way when the paint is wet, but collect together and become a solid coating as the paint dries in the air.

"It appears that perfectly normal proteins are capable of aggregating to form threads that then accumulate to choke these cells," Woodard said. "The mystery is why for many people these proteins can remain soluble and function normally in the brain for an entire lifetime, while in other cases the same proteins undergo aggregation."

Answering that small riddle may prove to be the fundamental element in solving the whole problem.

"Sometimes we can provide a piece of the puzzle that is vital in all the other pieces fitting together," Tipton said.

Depending on what a space-based experiment shows, the researchers say they would still be far removed from testing on actual brains.

"We're several years from working on brains," Tipton said. "We're still working to demonstrate that this theory could indeed be the cause of protein aggregation into the types of fibers that are seen in brains."

Both Tipton and Woodard are confident their theory is on the right track to detecting the cause of the brain-crippling diseases.

"In the vast majority of people who get Alzheimer's, no genetic change has been identified," Woodard said. "The proteins are in fact genetically normal, so something else must be the driving factor in causing aggregation. We believe it must have something to do with colloidal forces. We have to remember that proteins are still just ordinary chemicals and are subject to non-biological actions."

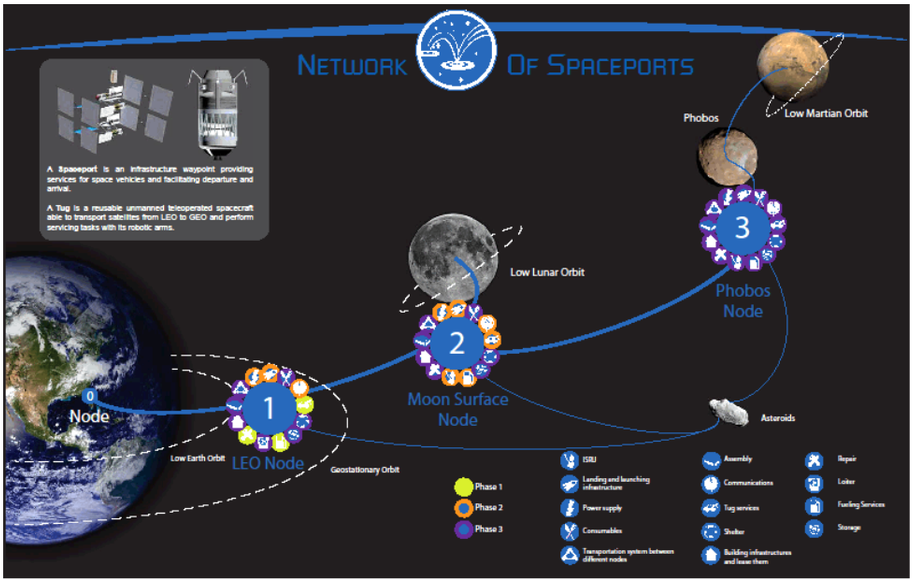
# Refueling in space expected to spur future exploration

*By Cheryl Mansfield*
*Spaceport News*

The recent successful robotic refueling exercises conducted at the International Space Station (ISS) may foreshadow what a group of international space students see as the key to future exploration of the solar system.

Under the umbrella of the International Space University, 34 participants from 19 different countries produced the Operations and Service Infrastructure for Space (OASIS) plan featuring a network of non-terrestrial spaceports. Their concepts, put forth in the project report, also echo the international cooperation that the space station now exemplifies.

"The refueling technologies demonstrated on the ISS pave the way for future on-orbit spaceports that will refuel spacecraft with propellants made from water launched from Earth, water ice found at the lunar poles, and possibly wet asteroids," said Kennedy Space Center's Rob Mueller, who served as OASIS team project co-chair.




*CLICK ON PHOTO* *NASA image*

The 50-year, three-phased plan for the Operations and Service Infrastructure for Space (OASIS) project, views the moon, asteroids and Mars as waypoints to be used for the exploration of the solar system, providing refueling points for longer journeys by using propellants created from available space resources and solar energy. For more on OASIS, click on the photo.

And while the space station demonstration was aimed at refueling satellites in geosynchronous orbit, the ambitious OASIS proposal aims at enabling spaceships to travel further into the solar system. The 50-year, three-phased plan views the moon, asteroids and Mars as waypoints to be used for the exploration of the solar system, providing refueling points for longer journeys by using propellants created from available space resources and solar energy.

"This OASIS study is visionary and would take 15 to 20 years to implement the first extraterrestrial spaceports, but the technologies needed to do this are currently in the early stages of development at NASA, as well as at new space companies, and are feasible," said Mueller. "A particularly interesting aspect of this study is the proposed formation of an International Spaceport Authority where 14 countries would create a legal and space-based infrastructure framework to allow routine and affordable space transportation to occur."

The OASIS-proposed waypoints, or spaceports, would provide a network of supply stations and operations beginning in low-Earth orbit, and continuing on to the moon, as well as the Martian moon Phobos. The goal of creating these stations would be to make space travel more affordable and accessible by providing intermediate, multipurpose locations for staging, launch and resupply -- in essence, steppingstones to the further reaches of our solar system.

The emphasis for the development of this network is both international and commercial for human and robotic missions, and NASA's involvement will continue as the OASIS Next project follows the initial proposal.

Kennedy Space Center and the Florida Institute of Technology co-hosted the International Space University's 25th annual Space Studies Program in Florida.

Mueller said, "The innovative ideas presented by the diverse student team in project OASIS will be used to inform and stimulate further debate and analysis regarding the future direction of our space program."

# Space shuttle Atlantis' new home to open on June 29

*By Bob Granath*
*Spaceport News*

Kennedy Space Center Visitor Complex recently marked another milestone in the construction of the new home for space shuttle Atlantis by unveiling the official identity for the exhibit and its grand opening date -- June 29.

After weeks of considering many different concepts, the identity that resonated most powerfully with guests of all ages was unveiled -- a simple design stating, "Space Shuttle Atlantis." The logo will appear on monument signage at the entry, on retail merchandise, and on marketing and promotional materials.

"We are so proud to partner with NASA to build the only place in the world to experience the remarkable voyage of Atlantis -- one of the most storied spacecraft in the U.S. space program," said Rick Abramson, president of Delaware North Companies Parks and Resorts. "Without question, Kennedy Space Center is the best place to experience, learn about and be inspired by space exploration – past, present and future."

Atlantis made the journey to its new home on Nov. 2, 2012, traveling 10 miles from the Vehicle Assembly Building to the $100 million exhibit facility that will showcase the shuttle. Since then, Atlantis was raised 30 feet off the ground and rotated 43.21 degrees to be displayed as if it were in space. Its nose is 26.5 feet off the ground while its portside wingtip is only 7.5 feet from the floor.

Displays in the 90,000-square-foot facility will tell the compelling story of the entire shuttle program, including the thousands of people working behind the scenes. Exhibits will include the shuttle program's key role in the launch and servicing of the Hubble Space Telescope, as well as development of the International Space Station.

More than 60 interactive exhibits and simulators will provide guests a never-before-experienced perspective on the shuttle's complex systems, components and capabilities. The new facility also will showcase how the shuttle program paved the way for the future of space exploration.

"Although the multimillion-dollar interactive exhibit encompasses much, much more than the display of Atlantis, there is no denying, she is truly the star of the show," said Bill Moore, chief operating officer of the visitor complex. "We know that this majestic beauty, which safely ferried men and women to space and back on 33 successful missions, is the real reason that our guests will travel thousands of miles … to see her in all her glory."

Mike Konzen, chairman and CEO

To **ATLANTIS**, Page 12

# Looking up and ahead . . .

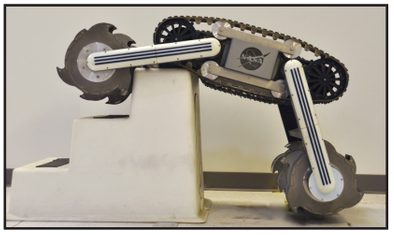
**** All times are Eastern***

**2013**
**March 28**
**Assembly Flight:** 34S
**Mission:** Expedition 35/36
**Launch Vehicle:** Soyuz TMA-08M
**Launch Site:** Baikonur Cosmodrome, Kazakhstan
**Description:** Soyuz TMA-08M will carry three Expedition 35/36 crew members to the International Space Station.

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

## New RASSOR video

RASSOR, which is 2.5 feet high and expected to weigh 100 pounds, was featured in the Feb. 8, 2013, issue of Spaceport News. To watch a video of the blue-collar robot, click on the photo.



*NASA/Jason Schuler*

From **ATLANTIS**, Page 11

of St. Louis-based PGAV Destinations, explained that the logo for "Space Shuttle Atlantis" was created with a gradient of fiery oranges representative of the shuttle's launch and re-entry to Earth. These symbolic colors also were used in the metallic "swish" on the outside of the new exhibit building.

Another milestone in the exhibit's construction is scheduled to be achieved in March with the beginning of the installation of a full-scale external fuel tank and twin solid rocket boosters at the entry to Space Shuttle Atlantis. These components of the space shuttle "stack" will serve as a gateway, with guests walking beneath the massive orange external tank, which will be suspended 24 feet above the ground, mounted between the two solid rocket boosters and reaching 185 feet into the air. Installation of the entryway structure will be completed in June.

Construction also continues on schedule inside the exhibit. In May, Atlantis will be unveiled from the shrink wrap that was applied in November 2012 to protect it from construction dust and debris. The payload bay doors then will be opened and Atlantis' Canadarm remote manipulator system -- its robotic arm -- also will be installed and extended.

"There are no words to accurately describe the emotions and insights guests will gain when this attraction opens this summer," Moore said, "for there has truly never been anything like it before."


*Graphic courtesy of the Kennedy Space Center Visitor Complex*

A simple design stating "Space Shuttle Atlantis" is the official identity for the new Atlantis exhibit.

# *NASA Spinoffs: Did you know?*

March is known as the "green" month, and the world has become a greener place with a lot of help from NASA.

NASA-led research has developed a leaf sensor that can monitor plants using electrical pulses, allowing anyone from astronauts to farmers to measure plant water levels directly. This technology allows "thirsty" plants to send text messages to farmers asking for more water.

Kennedy Space Center has developed a method using LED lighting for growing crops in space. This technology allows for precision and control, and uses less power than traditional lamps. The lighting systems can be adapted to specific plant species during a specific growth stage, allowing maximum efficiency in light absorption.

Kennedy Space Center-led research into aeroponics has reduced water usage by 98 percent, fertilizer usage by 60 percent, and pesticide usage by 100 percent, all while maximizing crop yields by 45 to 75 percent. By conserving water and eliminating harmful pesticides and fertilizers, growers are doing their part to protect the Earth.

A miniature rose plant, called the "Overnight Scentsation," flew aboard space shuttle Discovery during its STS-95 mission. After some research and testing, the rose produced the first fragrance not created on Earth. This unique "space rose" scent is now a fragrance ingredient in a perfume called "Zen."

For more about NASA Spinoffs,, go to **http://www.nasa.gov/spinoffs**.

John F. Kennedy Space Center

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