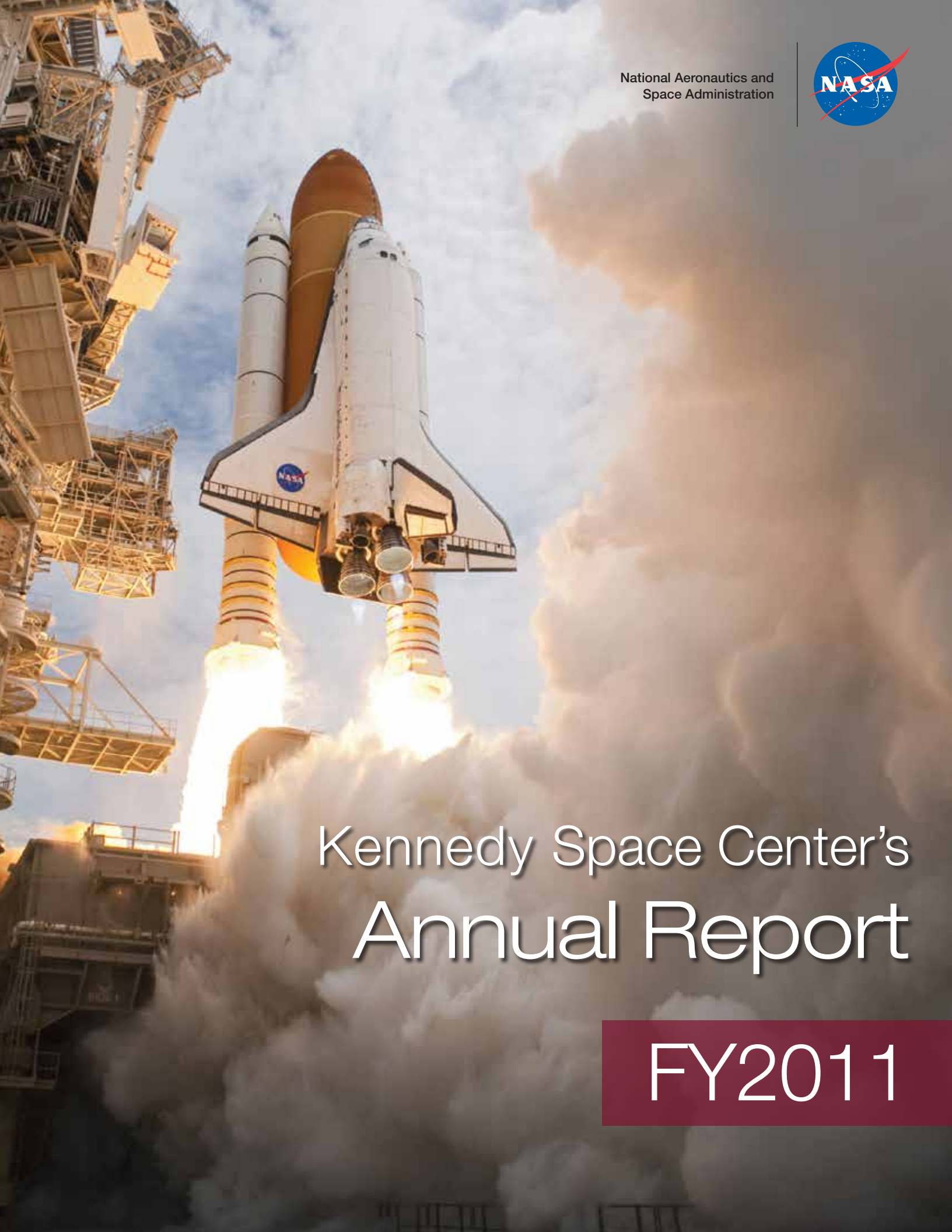
National Aeronautics and
Space Administration



Kennedy Space Center's Annual Report

FY2011

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Space shuttle Discovery pauses for photos during its move called "rollover" from Orbiter Processing Facility-3 to the nearby Vehicle Assembly Building on Sept. 9, 2010.

Bathed in xenon lights, space shuttle Atlantis embarks on its final journey from the Vehicle Assembly Building to Launch Pad 39A at 8:42 p.m. EDT, May 31, 2011.

Center Director's Message

During fiscal year 2011, a dedicated and diverse workforce at Kennedy Space Center helped to process NASA's last three space shuttle missions and bring to a close 30 years of Space Shuttle Program flights.

At the same time, Kennedy began transitioning from a historically government-only launch facility, which supported shuttle missions and construction of the International Space Station, to a multi-purpose spaceport, supporting research and development aboard the space station and serving different types of missions, rockets and spacecraft, both governmental and commercial.

Kennedy and the world watched as space shuttles Discovery, Endeavour and Atlantis launched on their final missions, all to the International Space Station. Final payloads processed in Kennedy's Space Station Processing Facility, including the Permanent Multipurpose Module and the Alpha Magnetic Spectrometer-2, were delivered to the space station.

The long-established Launch Services Program (LSP) based at Kennedy oversaw the launch of three NASA missions from the east and west coasts, including the Aquarius/SAC-D observatory, Juno mission to Jupiter, and the twin Gravity Recovery and Interior Laboratory (GRAIL) spacecraft, named Ebb and Flow, bound for the moon. LSP also spent the year preparing the Mars Science Laboratory (MSL) for launch in November 2011 and is scheduled to arrive at Mars in August 2012.

As we move forward, Kennedy is leading efforts in two newly-established programs and a new center office that are among several supporting NASA's next steps in space exploration. These are the Ground Systems Development and Operations Program, the Commercial Crew Program and the Ground Processing Directorate.

In the last several years leading up to the shuttle program's retirement, we've emphasized that partnering is the key to the center's future. In fiscal year 2011, Kennedy's Center Planning and Development Office was involved in discussions on dozens of agreements, many of which are partnerships with commercial companies.

Kennedy also will take the lead in some areas of technology capabilities with assistance from other NASA centers. These capabilities include life sciences and habitation systems, space launch and suborbital technologies, and tracking, timing, communications and navigation techniques.

NASA marked the 10th anniversary of continuous human presence on the International Space Station in November 2010. Men and women from 15 nations have lived and worked together on the station and conducted more than 600 research and technology experiments.

These are just a few highlights of the many accomplishments that were achieved by the outstanding workforce here at Kennedy Space Center.

Robert D. Cabana
Center Director

Vision, Mission & Core Competencies

KSC Vision

KSC is the world's preeminent launch complex for government and commercial space access, enabling the world to explore and work in space.

KSC Mission

KSC safely manages, develops, integrates and sustains space systems through partnerships that enable innovative, diverse access to space and inspires the nation's future explorers.

KSC Core Competencies

- Acquisition and management of launch services and commercial crew development
- Launch vehicle and spacecraft processing, launching, landing and recovery, operations and sustaining engineering
- Payload and flight science experiment processing, integration and testing
- Designing, developing, operating, and sustaining flight and ground systems, and supporting infrastructure
- Development, test and demonstration of advanced flight systems and transformational technologies
- Developing technology to advance exploration and space systems

Significant Events

1. **Oct. 11, 2010: Commercial Crew Program becomes NASA's future**
   President Obama and Congress approve the creation of NASA's Commercial Crew Program and future direction of the agency with the signing of the 2010 NASA Authorization Act.

2. **Oct. 19, 2010: Memorial to fallen employees dedicated**
   A memorial was dedicated to those who died on the job at Kennedy and Cape Canaveral Air Force Station in service to America's space program. Sponsored by the U.S. Space Walk of Fame Foundation and located in Space View Park in Titusville, Fla., their names are engraved on one of the Apollo memorial's pylons.

3. **Nov. 2, 2010: NASA marks 10th anniversary of life on space station**
   NASA celebrated 10 years of continuous living on the International Space Station (ISS) and the completion of 57, 361 orbits of Earth, or about 1.5 billion miles. Men and women from 15 nations have lived and worked together on the station and conducted more than 600 research and technology experiments.

4. **Nov. 11, 2010: NASA awards new engineering services contract**
   NASA selected QinetiQ North America of McLean, Va., to provide engineering services and products at Kennedy.

5. **Dec. 8, 2010: First COTS Program flight test a success**
   SpaceX tested its Falcon 9 rocket and a fully functioning Dragon spacecraft combination during a brief mission launched from Space Launch Complex-40 on Cape Canaveral Air Force Station in Florida. The flight was the first for NASA's Commercial Orbital Transportation Services (COTS) Program.

6. **Jan. 20, 2011: LEED Platinum building unveiled**
   Kennedy unveiled its newest environmentally friendly building, the Propellants North Administrative and Maintenance Facility. It qualified for the U.S. Green Building Council's Leadership in Energy and Environmental Design, or LEED, Platinum status, which is the highest of green building certifications. The new building will help Kennedy prepare for future projects.

7. **Feb. 24, 2011: Discovery lifts off on its last mission**
   Space shuttle Discovery roared off Launch Pad 39A at 4:53 p.m. EST to begin the last of its historic missions, STS-133. The launch originally was scheduled for Nov. 5, 2010, but was delayed by a problem with the ground umbilical carrier plate (GUCP) and a crack in the orange foam near the top of the external fuel tank's midsection.

8. **March 1, 2011: NASA implements 2010 Authorization Act with creation of Commercial Crew Program Office**
   NASA announced that Kennedy Space Center will lead the way in enabling commercial human spaceflight capabilities with the establishment of the Commercial Crew Program Office, the first at the center for human spaceflight.

9. March 9, 2011: Discovery ends illustrious career with return from space

Discovery touched down at Kennedy's Shuttle Landing Facility at 11:57 a.m. EST to complete the 13-day, 5.3-million-mile STS-133 mission to the International Space Station. The shuttle and its crew of six astronauts delivered the last pressurized module to the U.S. side of the orbiting outpost, a large closet of sorts called the Permanent Multipurpose Module. Discovery, the longest-serving veteran of NASA's space shuttle fleet, flew 39 missions, spent 365 days in space, orbited Earth 5,830 times and traveled 148,221,675 miles since 1984.

10. March 11, 2011: Kennedy-sponsored Pink Team wins Florida FIRST competition

The Kennedy-sponsored Pink Team participated in the regional For the Inspiration and Recognition of Science and Technology (FIRST) Robotics Competition at the University of Central Florida in Orlando. The team, made up of students from Rockledge, Cocoa Beach and Viera high schools, was the winning alliance in the Florida FIRST Robotics Competition, where they also took home the Industrial Design Award sponsored by General Motors.

11. April 12, 2011: Retirement locations of space shuttles announced

NASA Administrator Charlie Bolden announced on the 30th anniversary of the first space shuttle launch, that shuttle Atlantis will remain on permanent exhibition at the Kennedy Space Center Visitor Complex.

12. April 17, 2011: New weather instrumentation activated on Launch Pad 39B

A new comprehensive weather instrumentation system installed on the lightning protection towers at Launch Pad 39B is providing up-to-the-second and extremely accurate measurements at different locations and altitudes. The improvements are expected to produce increasingly detailed launch criteria that could lead to more on-time liftoffs for a variety of rockets in the future.

13. April 18, 2011: Companies chosen for NASA's Commercial Crew Development effort

NASA awarded approximately $270 million to four commercial companies to continue development of commercial rockets and spacecraft capable of safely flying astronauts into orbit and to the International Space Station. The award was the second phase of the agency's Commercial Crew Development effort, known as CCDev2.

14. May 5, 2011: 50th anniversary of the first U.S. manned spaceflight commemorated

More than 200 workers from the original Mercury Program joined NASA Administrator Charlie Bolden and Kennedy Center Director Bob Cabana on Cape Canaveral Air Force Station for a re-creation of Alan Shepard's flight and recovery to commemorate the 50th anniversary of the first U.S. manned spaceflight.

15. May 7, 2011: U.S. Astronaut Hall of Fame induction

Former astronauts Karol J. "Bo" Bobko and Susan J. Helms were inducted into the U.S. Astronaut Hall of Fame. Their inductions brought the total number of space explorers enshrined to 79.

16. May 16, 2011: Endeavour launches on final mission

Space shuttle Endeavour launched for the 25th and final time from Launch Pad 39A at 8:56 a.m. EDT on the STS-134 mission to deliver the Alpha Magnetic Spectrometer-2 (AMS) and critical supplies to the space station.

17. **May 26, 2011: U.S. Honor Flag presented to NASA**
The U.S. Honor Flag was presented by James Loftus, director of the Miami-Dade Police Department, to Kennedy Center Director Bob Cabana for flight aboard shuttle Atlantis on its final mission. The flag has traveled throughout the world honoring heroes who lost their lives while serving their community and country to include police officers, firefighters, members of the Armed Forces and astronauts.

18. **June 1, 2011: Endeavour sails to home port for the final time**
Space shuttle Endeavour and its six-astronaut crew sailed home for the final time, ending a 16-day journey at 2:35 a.m. EDT at Kennedy's Shuttle Landing Facility. STS-134 was the last mission for the youngest of NASA's space shuttle fleet. Since 1992, Endeavour flew 25 missions, spent 299 days in space, orbited Earth 4,671 times and traveled 122,883,151 miles.

19. **June 10, 2011: NASA's Aquarius/SAC-D observatory rockets into space from California**
NASA's "Age of Aquarius" dawned with a launch on a Delta II rocket from Vandenberg Air Force Base (VAFB) in California at 10:20 a.m. EDT. The international satellite carried the agency-built Aquarius instrument that will measure the saltiness of Earth's oceans to advance our understanding of the global water cycle in order to improve climate forecasts.

20. **June 15, 2011: New Ground Systems Development and Operations Program**
NASA's new Ground Systems Development and Operations Program, formerly the 21st Century Ground Systems Program, was officially stood up at Kennedy.

21. **June 16, 2011: The final space shuttle payload is delivered to the launch pad**
The payload canister carrying the Raffaello multi-purpose logistics module for the final space shuttle mission, STS-135, arrived at Launch Pad 39A for transport to the International Space Station aboard shuttle Atlantis.

22. **July 7, 2011: NASA and Sierra Nevada Corp. Space Systems enter into agreement**
NASA and Sierra Nevada Corp. Space Systems of Sparks, Nev., enter into a Space Act Agreement (SAA) that will offer the company technical capabilities from Kennedy's uniquely skilled workforce.

23. **July 8, 2011: Atlantis roars off Launch Pad 39A on the final space shuttle mission**
Space shuttle Atlantis launched at 11:29 a.m. EDT on the STS-135 mission carrying the Raffaello multi-purpose logistics module to deliver supplies, logistics and spare parts to the International Space Station.

24. **July 13, 2011: U.S. Senate acknowledges end of the Space Shuttle Program**
The U.S. Senate unanimously passed Resolution 233, honoring America's space agency and its workers. The Senate acknowledged that the Space Shuttle Program has driven innovation in the fields of science, technology, engineering and mathematics to benefit the people of the United States and all of humankind.

25. **July 18, 2011: NASA begins commercial partnership with United Launch Alliance**
Through a new, unfunded Space Act Agreement, United Launch Alliance (ULA) will provide technical information to NASA about using the Atlas V rocket to launch astronauts into space as part of the agency's Commercial Crew Development Round 2 activites.

26. July 21, 2011: Atlantis completes STS-135, the final spaceflight in the shuttle program

Space shuttle Atlantis completed its final spaceflight mission, STS-135. Wrapping up 30 years of unmatched achievements and blazing a trail for the next era of U.S. human spaceflight, NASA's Space Shuttle Program came to a "wheels stop" at 5:57 a.m. EDT, concluding its 135th mission. Since 1985, Atlantis few 33 flights, spent 307 days in space, orbited Earth 4,848 times and traveled 125,935,769 miles.

27. Aug. 5, 2011: Juno spacecraft starts its five-year journey to Jupiter

Juno was launched atop an Atlas V rocket at 12:25 p.m. EDT from Space Launch Complex 41 at CCAFS on its way to Jupiter on a mission to look deep beneath the planet's swirling curtain of clouds.

28. Aug. 29, 2011: NASA and KT Engineering enter into agreement

A non-reimbursable Umbrella Space Act Agreement (SAA), signed by Center Director Bob Cabana and KT Engineering in Madison, Ala., will help the agency acquire the knowledge necessary to develop a multi-user ground system architecture for launching nontraditional, low-cost vehicles.

29. Sept. 9, 2011: CASIS to manage station's U.S. national laboratory

The Center for the Advancement of Science in Space (CASIS) was awarded management of the portion of the International Space Station that is operated as a U.S. national laboratory. CASIS will base its efforts at Kennedy's Space Life Sciences Laboratory and help ensure the space station's unique capabilities are made available to the broadest possible cross-section of U.S. scientific, technological and industrial communities.

30. Sept. 10, 2011: Twin GRAIL probes launch to lunar orbit

A United Launch Alliance Delta II heavy rocket successfully sent NASA's twin moon-bound Gravity Recovery and Interior Laboratory (GRAIL) spacecraft on their way from Cape Canaveral Air Force Station (CCAFS) in Florida at 9:08 a.m. EDT.

31. Sept. 13, 2011: NASA and ATK enter agreement

NASA entered into an unfunded Space Act Agreement with Alliant Techsystems (ATK) that could help speed up the availability of U.S. commercial crew transportation capabilities to the International Space Station and low Earth orbit. The agreement will allow a partnership on the development of ATK's Liberty launch system as part of the agency's Commercial Crew Development Round 2 activities.

32. Sept. 19, 2011: NASA releases Commercial Crew draft RFP

NASA unveiled an outline of its acquisition strategy to procure transportation services from private industry to carry U.S. astronauts to low Earth orbit and the International Space Station. The agency also announced the addition of optional milestones for the Commercial Crew Development Round 2 (CCDev2) initiative.

33. Sept. 30, 2011: NASA awards new security and support contract

NASA selected Chenega Security and Support Solutions LLC of Ashburn, Va., to provide services at Kennedy.

Xenon lights illuminate space shuttle Discovery and create a mirror image in the Turn Basin as the space vehicle rolls out to Launch Pad 39A from the Vehicle Assembly Building on Jan. 31, 2011.

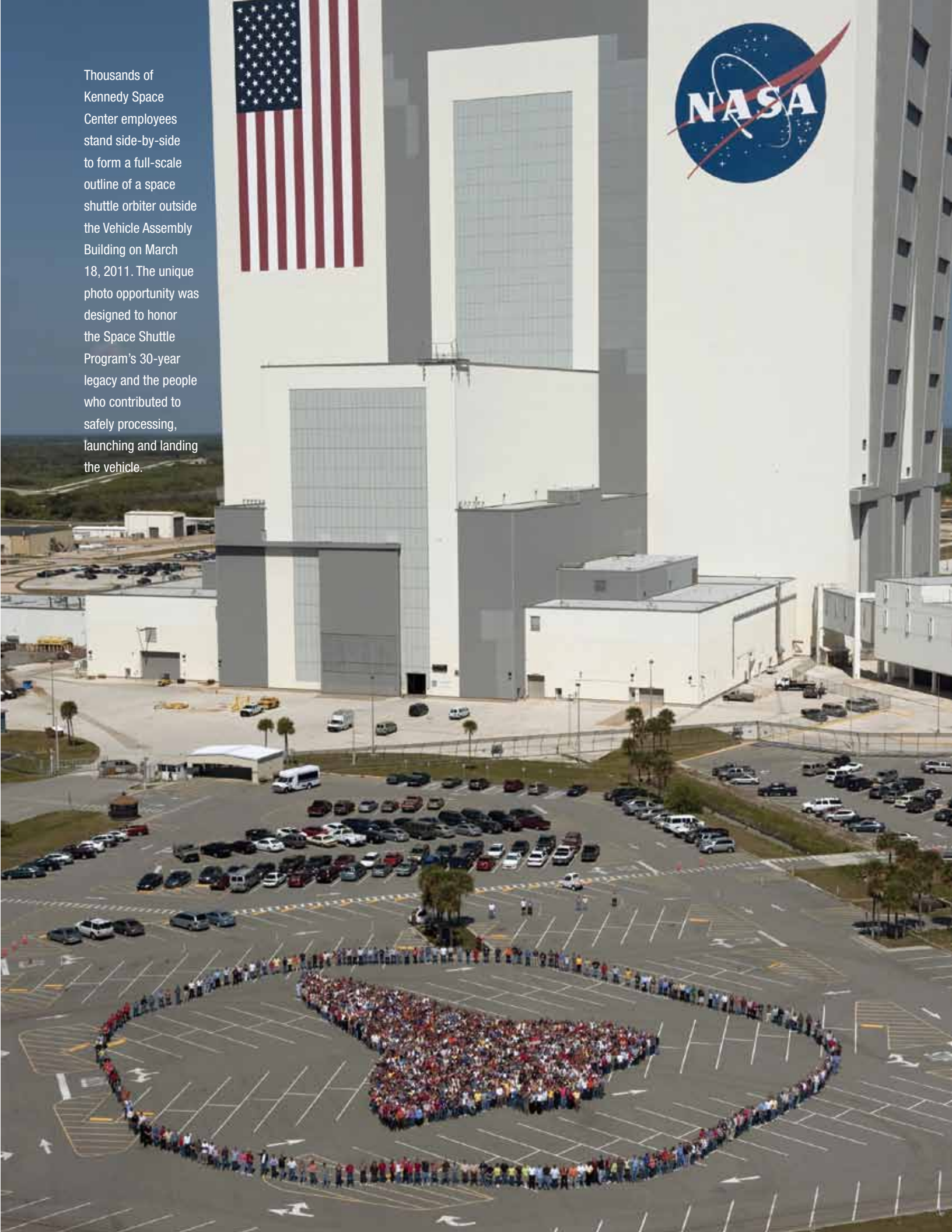
In a swirl of billowing smoke and steam, space shuttle Discovery's liftoff is reflected in the water as it roars off Launch Pad 39A at 4:53 p.m. EST on Feb. 24, 2011, on its final flight to the International Space Station on the STS-133 mission.

In the Vehicle Assembly Building, space shuttle Endeavour is lowered into place where it is being attached to its external fuel tank and solid rocket boosters, already positioned on the mobile launcher platform March 1, 2011.

Vapor trails follow space shuttle Atlantis as it approaches Runway 15 on the Shuttle Landing Facility for the final time, July 21, 2011.

Space shuttle Endeavour began its slow trek from the Vehicle Assembly Building to Launch Pad 39A at 7:56 p.m. EST on March 10, 2011.

Space shuttle Atlantis' main engines and solid rockets boosters ignite on Launch Pad 39A as it lifts off past the tower into the clouds at 11:29 a.m. EDT on July 8, 2011, on its final flight, STS-135, to the International Space Station.



Thousands of Kennedy Space Center employees stand side-by-side to form a full-scale outline of a space shuttle orbiter outside the Vehicle Assembly Building on March 18, 2011. The unique photo opportunity was designed to honor the Space Shuttle Program's 30-year legacy and the people who contributed to safely processing, launching and landing the vehicle.

Launch Vehicle Processing

During Fiscal Year 2011, Kennedy Space Center's Launch Vehicle Processing Directorate and the ground operations processing team prepared space shuttles Atlantis, Discovery and Endeavour for their final missions into space and completed 30 years of NASA's Space Shuttle Program. These final three missions, one for each orbiter, also completed the final assembly of the International Space Station.

Several challenges were overcome, including those of a technical nature and the implementation of personnel reductions as the Space Shuttle Program came to a historic and successful completion.

Now, transition and retirement work is being performed on NASA's three space shuttles to preserve them for display at locations around the country.

FINAL SPACE SHUTTLE MISSIONS

Mission STS-133/Discovery

The shuttle processing team overcame several technical challenges as Discovery was prepared for its final mission. Discovery first rolled out to Launch Pad 39A in September 2010; however, a fuel leak during propellant loading was discovered. The teams quickly analyzed and corrected the leak, but subsequent analysis on the external fuel tank structure determined that a return to the Vehicle Assembly Building (VAB) was required to accommodate required modifications to fix the structural issues. After the modifications were completed, extensive testing performed and a great deal of engineering analysis conducted by teams across the Space Shuttle Program, Discovery once again returned to the pad in February 2011.

Discovery launched Feb. 24, 2011, at 4:53 p.m. EST, on its 39th and final mission. It was the 133rd space shuttle mission and the 35th mission to the International Space Station.

On its third day of flight, Discovery docked with the space station and delivered the Expedite the Processing of Experiments to the Space Station (ExPRESS) Logistics Carrier. The crew also delivered the Permanent Multipurpose Module Leonardo to the station. Extensive outfitting and cargo transfers then were conducted during the next several days. Mission specialists performed two spacewalks during the flight.

Discovery touched down at Kennedy's Shuttle Landing Facility at 11:57 a.m. EST on March 9, after spending 13 days in space.

Upon landing, Discovery was retired after completing an amazing career of accomplishments. Discovery flew 39 successful missions during its 27 years in service, having first launched from Kennedy on Aug. 30, 1984. NASA's third

On Launch Pad 39A, technicians reattach the vent line to the ground umbilical carrier plate on space shuttle Discovery's external fuel tank for the STS-133 mission to the International Space Station.

In Orbiter Processing Facility-2, United Space Alliance mid-body shop mechanical technicians remove the main landing gear brakes on space shuttle Endeavour to prepare for the STS-134 mission. The shuttle's tires were replaced following each flight, and the brakes were replaced after every eighth flight.

operational orbiter carried 252 crew members, flew 365 days in space and more than 148 million miles, the most of any orbiter.

Mission STS-134/Endeavour

During Endeavour's STS-134 mission processing flow, the team overcame several challenges that enabled Endeavour to make its final journey to Launch Pad 39A on March 10, 2011. The illuminated rollout from VAB high bay 3 was witnessed by thousands of Kennedy employees, their families and invited guests.

Endeavour began the STS-134 mission with a spectacular early morning launch on May 16, 2011, at 8:56 a.m. EDT. After a flawless ascent into orbit, Endeavour arrived at its destination, the International Space Station, on Flight Day 3. That same day, the crew removed the ExPRESS Logistics Carrier from Endeavour's payload bay and attached it to the space station.

Mission specialists helped attach the Alpha Magnetic Spectrometer-2 (AMS) to the space station on the fourth day of the mission. The AMS unit is a particle physics detector that contains a large permanent magnet which is designed to search for antimatter and investigate the origin and structure of dark matter.

Mission specialists also transferred the Orbiter Boom Sensor System (OBSS) from Endeavour for permanent use on the station. It will be used to reach places that the Canadarm2 can't get to on its own. The crew performed three spacewalks to further complete the outfitting and assembly of the station.

Endeavour safely touched down with a nighttime landing at Kennedy's Shuttle Landing Facility at 2:35 a.m. EDT on June 1, 2011, completing a 16-day mission.

Endeavour was retired after completing a historic list of accomplishments. Endeavour flew 25 successful missions during its 19 years in service, having first launched from Kennedy on May 7, 1992. NASA's fifth and newest orbiter carried 173 crew members, flew 299 days in space and traveled more than 122 million miles.

Mission STS-135/Atlantis

Processing of the last flight of the Space Shuttle Program began with the arrival of the final flight components. External fuel tank 138 (ET-138) left the Michoud Assembly Facility in New Orleans on the Pegasus barge and arrived at Kennedy on July 13, 2010. After offloading, the tank was transported into a checkout cell inside the VAB.

Stacking operations of the solid rocket boosters for the mission commenced in March 2011. As a historical note, the upper cylinder on the left booster flew previously on STS-1, the maiden flight of space shuttle Columbia on April 12, 1981.

Atlantis began its journey to the VAB on May 17, 2011, and was attached to ET-138 and the twin solid rocket boosters on May 18. Space shuttle Atlantis rolled out, for the final time, to Launch Pad 39A on June 1. As Atlantis was traveling to the pad overnight, Endeavour was touching down a few miles away on the Shuttle Landing Facility following

Workers and the crew of STS-135 hold up a "We're Behind You Atlantis" banner during the final planned move of shuttle Atlantis from Orbiter Processing Facility-1 to the Vehicle Assembly Building on May 17, 2011.

its highly successful STS-134 mission.

A tanking test performed at the pad revealed a fuel valve leak, which was successfully repaired.

The final launch of the space shuttle occurred July 8, 2011, at 11:29 a.m. EDT. Atlantis climbed flawlessly into orbit, and the Atlantis crew began in-orbit operations. The crew of the International Space Station welcomed the shuttle crew upon its arrival on Flight Day 3. The following day, the multi-purpose logistics module (MPLM) Raffaello was unberthed from the payload bay and attached to the space station. Throughout the course of the docked portion of the mission, 9,403 pounds of cargo was transferred to the space station and 5,666 pounds of cargo was loaded into the MPLM for return to Earth.

In the Space Shuttle Main Engine Processing Facility, one of six space shuttle main engines is prepared for Endeavour's STS-134 mission. Postflight inspections and maintenance of each engine were conducted in the facility between shuttle missions by Pratt & Whitney Rocketdyne aerospace technicians.

After traveling more than 5.2 million miles in orbit, Atlantis completed the 135th and final space shuttle mission by touching down at Kennedy's Shuttle Landing Facility on July 21, 2011, at 5:57 a.m. EDT. The pre-dawn touchdown heralded the end of NASA's 30-year Space Shuttle Program.

Upon landing for the final time, Atlantis was retired after completing a remarkable history of spaceflights. Atlantis flew 33 successful missions during its 26 years in service, having first launched from Kennedy on Oct. 3, 1985. NASA's fourth orbiter carried 207 crew members, flew 307 days in space, completed 4,848 orbits of the Earth and traveled more than 125 million miles.

Beginning with the STS-1 mission, that launched April 12, 1981, 355 individuals from 16 countries flew on the space shuttle. More than 2,000 experiments

in the fields of Earth, astronomy, biological and materials sciences were conducted aboard the space shuttle.

Combined, all five of NASA's space shuttles (Columbia, Challenger, Discovery, Endeavour and Atlantis) have traveled more than 542 million miles and made more than 21,000 Earth orbits.

TRANSITION AND RETIREMENT

Almost immediately after each space shuttle landed, work began in the orbiter processing facilities and the VAB to prepare them for permanent public display.

Discovery now is on display at the Smithsonian's Udvar-Hazy Center in Washington, D.C. On April 17, 2012, Discovery was transported atop the Shuttle Carrier Aircraft from Kennedy's Shuttle Landing Facility to the Dulles International Airport in Virginia.

Endeavour is being prepared for public display at the California Science Center in Los Angeles.

Atlantis is being prepared for display at the Kennedy Space Center Visitor Complex in Florida. A July 2013 grand opening is targeted for Atlantis' new exhibit hall.

Transition and retirement work included removal of the space shuttle main engines from each vehicle. The main engines will be retained for possible use on NASA's Space Launch System vehicle. Replica shuttle main engines (RSMEs) were created in the Pratt & Whitney Rocketdyne engine shop. RSMEs created for Discovery were made to look like they had just returned from space in order to satisfy specific historical requirements for the Smithsonian.

Each vehicle's orbital maneuvering system (OMS) pods and forward reaction control system (FRCS) were removed and sent to White Sands Space Harbor in New Mexico where they underwent a complete deservicing and cleaning. They were returned to Kennedy and reinstalled on the orbiters.

Other components of each vehicle are being removed and retained for possible future use on NASA's Space Launch System. This includes the main propulsion system that was recently removed from Endeavour's mid-body.

Transition and retirement work also includes the safing and turnover of facilities. Hundreds of facilities and tens of thousands of property items, such as ground support equipment, are being transitioned from Space Shuttle Program usage. Some of these assets will be used to support future programs. ■

In a unique nose-to-nose view, space shuttle Discovery, at right, switched places with Endeavour on Aug. 11, 2011, as part of transition and retirement work. Discovery was heading from the Vehicle Assembly Building (VAB) to Orbiter Processing Facility-1, while Endeavour was heading from OPF-1 to the VAB.

Ground Processing

The Ground Processing Directorate began operations in August 2011 as part of the network of new organizations built to streamline Kennedy Space Center's transition to a versatile and innovative spaceport that can host many kinds of rockets and spacecraft.

The organization drew its staff of about 200 people from several directorates, including Launch Vehicle Processing, Launch Integration, International Space Station and Spacecraft Processing, Constellation Project Office and Engineering. It began formal operations Aug. 14.

Ground Processing supports processing operations management, maintenance, sustaining engineering and logistics, as well as strategies and techniques to launch what could be a variety of rockets and spacecraft from Kennedy in the future. The directorate will focus mainly on projects with NASA's new Human Exploration and Operations Directorate, which covers operations supporting the International Space Station orbital replacement unit (spare parts), supplies and research processing, shuttle transition and retirement, Launch Services Program, along with support to the Ground Systems Development and Operations Program and the Space Launch System heavy-lift rocket.

The directorate also will work with the Center Planning and Development Office for host support to potential and new center customers, and integration of launch complex operations.

The organization is part of Kennedy's evolving network focused on establishing a multi-user spaceport. This is a unique calling for the center that has operated as the launch site of a single crewed launch vehicle at a time since the first American flew into space in 1961.

The work for the Ground Processing Directorate will include developing strong, cohesive relationships with many customers. The relationship is expected to pay off with several kinds of rockets and spacecraft being processed and launched at Kennedy. Along the way, Kennedy's expertise is expected to be called on for developing the machinery of successful processing and launches for craft that are not always alike. ■

Workers monitor the progress of space shuttle Atlantis as it is backed out of Orbiter Processing Facility-1 at NASA's Kennedy Space Center in Florida on May 17, 2011. Atlantis was on its final planned move to the Vehicle Assembly Building for the STS-135 mission to the International Space Station.

Space shuttle Atlantis soars past the American flag after lifting off Launch Pad 39A at 11:29 a.m. EDT on July 8, 2011.

International Space Station & Ground Processing Research

During Fiscal Year 2011, the International Space Station Ground Processing and Research Project Office at Kennedy Space Center processed the remaining U.S. components and several science and research experiments for delivery to the space station aboard NASA's final three space shuttle flights.

In November 2011, the center celebrated the 10-year anniversary of continuous human presence aboard the space station. On Nov. 2, the station completed 57,361 orbits of the Earth and traveled about 1.5 billion miles. Men and women from 15 nations have lived and worked together on the station.

On Oct. 25, 2011, the station set a record for being the longest continuously inhabited spacecraft. More than 600 research and technology experiments have been conducted on the station.

In the Space Station Processing Facility, the Alpha Magnetic Spectrometer-2 (AMS) is positioned to provide better access for work to be performed on its avionics box. AMS was delivered to the International Space Station aboard space shuttle Endeavour's final flight, the STS-134 mission.

Payload Processing

Two unpressurized Orbital Replacement Units, or ORUs, were processed in Kennedy Space Center's Space Station Processing Facility. The ORUs were the Flex Hose Rotary Coupler, or FHRC, and the Cargo Transportation Container, or CTC, which is a box containing five smaller ORUs.

The processing team integrated the FHRC to its flight support equipment and checked for continuity to ensure it was functioning properly and performed a gaseous nitrogen, or GN2, purge. Similar processing was completed for the CTC and then the smaller ORUs were integrated inside of it.

They were then shipped 7,500 miles by land, air and sea for final processing in Tanegashima, Japan, and transported to the space station aboard the Japanese H-II Transfer Vehicle in January 2011 for the HTV2 mission. It was the first time two unpressurized ORUs were delivered to the space station by a launch vehicle other than the space shuttle.

Payloads processed for Discovery's STS-133 mission included the Permanent Multipurpose Module (PMM) and the ExPRESS Logistics Carrier 4 (ELC-4).

One of the multi-purpose logistics modules was processed and prepared for permanent installation on the space station and was renamed the PMM.

One of the more unusual payloads on the STS-133 mission was a dexterous humanoid astronaut helper, known as Robonaut 2 (R2).

In the Space Station Processing Facility, technicians installed insulating blankets to the hatch of the Permanent Multipurpose Module (PMM) to protect it from the harsh environment and temperatures of space. The PMM was delivered to the International Space Station aboard space shuttle Discovery's final flight, the STS-133 mission.

NASA's R2 was checked and readied for packing and stored in the PMM for delivery to the station.

Although R2 initially will participate in operational tests aboard the station, upgrades could eventually allow the robot to realize its true purpose—helping spacewalking astronauts with tasks outside the orbiting laboratory.

For the STS-134 mission, the Alpha Magnetic Spectrometer-2 (AMS), the ExPRESS Logistics Carrier 3 (ELC-3) and a myriad of station hardware and middeck experiments were processed and prepared for launch aboard space shuttle Endeavour. Some of the payloads processed and secured on ELC-3 were an ammonia tank assembly, a high-pressure gas tank, the special purpose dexterous manipulator and an orbital replacement unit.

During the mission, AMS was attached to the station and became the first magnetic spectrometer in space. AMS, with its nine different science detectors, will collect information from cosmic sources emanating from stars and galaxies millions of light years beyond the Milky Way.

For the STS-135 mission, space shuttle Atlantis carried more hardware, supplies and logistics, and science components by weight in its payload bay and middeck than any other space shuttle mission.

The multi-purpose logistics module Raffaello and an external carrier that holds the Robotic Refueling Module (RRM) were processed and prepared for STS-135 in the SSPF. The refueling module was developed at Goddard Space Flight Center in Greenbelt, Md., and transported to Kennedy for final testing and processing.

During the mission, the RRM remained on the station and will be used to demonstrate robotic refueling of spacecraft as well as general space robotic repair and servicing operations.

Kennedy's operations and engineering teams developed a late cargo stowage plan for some enhanced pumps and equipment that arrived late for stowage on space station system racks.

ISS Research

The ISS research project management and science support provides the integration of research and science experiments to flight hardware through

Workers in the Space Station Processing Facility monitor the progress of the Heat Rejection Subsystem as is was transported by an overhead crane toward the Express Logistics Carrier-4, or ELC-4. Space shuttle Discovery delivered the ELC-4, filled with external payloads and experiments, to the International Space Station on its final flight, the STS-133 mission.

the entire research life cycle, including design, manifesting, flight operations products, ground controls and postflight processing as it relates primarily to plants but includes microbial and other biological systems as applicable.

Among the research and science experiments was a plant experiment developed and prepared for flight at Kennedy's Space Life Sciences Laboratory. The Biological Research in Canisters-Symbiotic Nodulation in a Reduced Gravity Environment (BRIC-SyNRGE) was the first of its kind to fly on a space shuttle.

During the STS-135 mission, crew members monitored the temperature of the BRIC-SyNRGE samples, 40 petri dishes in eight canisters, added a fixing liquid to half of the samples to preserve them for ground analysis in their in-orbit state and left the other half for other ground analysis. The purpose of the experiment was to study the symbiotic relationship between plants similar to alfalfa, which is in the legume family, and specific nitrogen-reacting bacteria in microgravity.

Another experiment developed in collaboration with Ames Research Center in Moffett Field, Calif., and processed at Kennedy for STS-135 was the Forward Osmosis Bag, which is a modified commercial off-the-shelf product designed to convert untreated water into a potable drink.

Research hardware continues to be improved. For example, the Biotube's imaging capability is being improved, and the Control and Data Management System and user interface are being upgraded.

As part of the development of flight research equipment for use on the space station, the Kennedy team made substantial progress on the BioTube, VEGGIE and Advance Plant Habitat (APH) flight systems. A critical design review was completed for VEGGIE and final design efforts began on the APH experiment. BioTube and VEGGIE are expected to be deployed to the space station during Fiscal Year 2013 and APH is expected to be deployed during Fiscal Year 2016. ■

Launch Services Program

During the year, LSP provided advance planning for more than 30 future expendable launch vehicle missions for NASA's Science Mission Directorate and Human Exploration and Operations Mission Directorate, and is actively procuring launch services for future NASA missions.

The office supported NASA's Science Mission Directorate during its announcement of opportunities for the Discovery 12, Explorers, Earth Venture and New Frontiers programs, as well as advanced planning for numerous science missions in early stages of design and development.

LSP continued its collaboration with the U.S. Air Force and the National Reconnaissance Office, particularly for launch vehicle certification approach and processes. It also continued to serve in a technical advisory role for the International Space Station Program's Commercial Resupply Services, the Commercial Crew Program and various science missions like the James Webb Space Telescope, Global Precipitation Measurement and Lunar Atmosphere and Dust Environment Explorer missions. LSP also promoted numerous partnership initiatives for the development and implementation of Poly-Picosatellite Orbital Deployer (PPOD) systems, supporting current and future missions for the CubeSat Initiative.

Flames and smoke from the engines surround the United Launch Alliance Delta II rocket at liftoff carrying NASA's twin Gravity Recovery and Interior Laboratory (GRAIL) mission off Space Launch Complex 17B on Cape Canaveral Air Force Station in Florida. The spacecraft launched at 9:08 a.m. EDT Sept. 10, 2011.

GRAIL

The Gravity Recovery and Interior Laboratory (GRAIL) mission to the moon launched on NASA's last scheduled Delta II Heavy rocket from Launch Complex 17B at CCAFS on Sept. 10, 2011, at 9:08 a.m. EDT.

GRAIL was processed at the Astrotech facility in Titusville, Fla. The processing flow was completed in tandem with preparing and processing NASA's Mars Science Laboratory for its mission.

In March 2012, GRAIL's twin spacecraft, Ebb and Flow, began high-quality gravity field mapping of the moon to determine its interior structure. GRAIL will fly in tandem orbits around the moon for several months to measure its gravity field in great detail. The spacecraft's primary science objectives will be to determine the structure of the lunar interior, from crust to core, and to advance understanding of the thermal evolution of the moon. Grail also will extend knowledge gained from the moon to the other terrestrial planets. The new information will help when targeting a landing site for any future missions. Each spacecraft will carry multiple cameras aboard to document their views and to allow students and the public to view observations from the satellites.

NASA's Juno planetary probe, enclosed in its payload fairing, launches atop a United Launch Alliance Atlas V rocket from Space Launch Complex 41 on Cape Canaveral Air Force Station in Florida. It's five-year journey to Jupiter began at 12:25 p.m. EDT Aug. 5, 2011.

JUNO

Juno, a mission to Jupiter, launched aboard an Atlas V rocket on Aug. 5, 2011, at 12:25 p.m. EDT, from Launch Complex 41 at CCAFS. Juno is part of NASA's New Frontiers Program. The spacecraft is the first mission to Jupiter that is powered by solar energy.

The LSP team met the challenge of processing a spacecraft with very large solar arrays and a launch vehicle that utilized more solid rocket motors than previous missions on an Atlas V launch vehicle.

About two years after launch, Juno will return to Earth for a gravity-assist flyby that gives the spacecraft the huge boost it needs to coast all the way out to Jupiter.

In July 2016, the solar-powered spacecraft will reach Jupiter and enter a highly elliptical orbit around the planet's poles that brings the spacecraft as close as 3,100 miles (5,000 kilometers) above the planet's cloud tops. The mission's primary goal is to improve our understanding of the formation, evolution and structure of the planet Jupiter. With its suite of nine instruments, Juno will investigate the existence of a solid planetary core, map Jupiter's intense magnetic field, measure the amount of water and ammonia in the deep atmosphere and explore the planet's auroras.

AQUARIUS/SAC-D Mission

Aquarius/SAC-D is a cooperative Earth Science project with NASA and Argentina's Comisión Nacional de Actividades Espaciales (CONAE). The Aquarius spacecraft launched aboard a Delta II on June 10, 2011, at 7:20 a.m. PDT (10:20 a.m. EDT) from Space Launch Complex 2 at VAFB.

At Astrotech's Hazardous Processing Facility in Titusville, Fla., technicians using an overhead crane lower NASA's Juno spacecraft to a fueling stand where the spacecraft was loaded with the propellant necessary for orbit maneuvers and the attitude control system on June 27, 2011.

In the Payload Hazardous Servicing Facility at NASA's Kennedy Space Center in Florida, technicians work beneath NASA's Mars Science Laboratory mission aeroshell, containing the compact car-sized rover Curiosity, which was mated to the cruise stage, on Oct. 11, 2011.

In Space Systems International's Payload Processing Facility at Vandenberg Air Force Base in California, technicians rotate the Aquarius/SAC-D spacecraft into a vertical position for testing on April 12, 2011.

NASA provided the primary instrument Aquarius, and launch services, while CONAE supplied the SAC-D spacecraft and ground system. The SAC-D spacecraft also carried a suite of seven other instruments with various science objectives.

For the first time in more than 10 years, the integrated processing facility called the Spaceport Systems International at VAFB was used to process the spacecraft.

During its prime three-year mission, Aquarius will provide unprecedented data to produce global maps of sea-surface salinity, measuring changes equivalent to about a "pinch" (1/8 of a teaspoon) of salt in one gallon of water. Within a few months, Aquarius will collect as many sea-surface salinity measurements as the entire 125-year historical record from ships and buoys.

Glory

NASA's Glory spacecraft launched on a Taurus XL rocket on March 4, 2011, at 5:09 a.m. EST, from Space Launch Complex 576-E at VAFB, but failed to reach orbit. The mission would have been the first of its kind dedicated to improving our understanding of how the sun and tiny atmospheric particles called aerosols affect Earth's climate. ■

Commercial Crew Program

For the first time since opening its doors 50 years ago, NASA's Kennedy Space Center is spearheading a program for launching men and women into space with the emergence of the Commercial Crew Program (CCP).

Working with a mandate to establish a fully functioning program capable of organizing a combined effort to send astronauts into low Earth orbit on privately funded and operated rockets, the Space Transportation Planning Office morphed into CCP in April 2011.

The program is ready to carry the torch of the Space Shuttle Program by human-rating commercial launch vehicles and spacecraft so America can routinely and affordably journey to the International Space Station and other low Earth orbit destinations around the middle of the decade. Currently, CCP is working with a roster of potential commercial space transportation providers, achieving significant milestones and setting goals for itself and the companies it is working with.

Building off the planning office's Commercial Crew Development Round 1 (CCDev1) activities, CCP hit the ground running in Fiscal Year 2011 with the release of a Request for Proposals (RFP) for space transportation systems on Oct. 25, 2010. The proposals were received in mid-December, followed by $269.3 million in awards in April 2011 to four companies to continue maturing systems for Commercial Crew Development Round 2 (CCDev2).

ULA

The industry partners selected during that second phase were Blue Origin of Kent, Wash., Sierra Nevada Corp. of Louisville, Colo., The Boeing Co. of Houston, and Space Exploration Technologies (SpaceX) of Hawthorne, Calif. Later in the year, the agency awarded $46.2 million in optional milestones pre-negotiated as part of some of the original CCDev2 Space Act Agreements to help accelerate development.

ATK

The program also entered into unfunded Space Act Agreements under CCDev2 to establish a framework of collaboration with other aerospace companies. As part of the agreements, NASA began to review and provide expert feedback to Alliant Techsystems Inc. (ATK) of Promontory, Utah, United Launch Alliance (ULA) of Centennial, Colo., and Excalibur Almaz Inc. of Houston on overall concepts and designs, systems requirements, launch vehicle compatibility, testing and integration plans, and operational and facilities plans.

Late in 2010, CCP helped NASA's Exploration Systems Mission Directorate develop an extensive set of safety requirements, standards and processes that will be applied to any NASA or NASA-sponsored commercial crew transportation mission. They are safety requirements that a system would have to meet before flight, rather than a traditional set of

requirements and solutions that would be levied down to every nut and bolt of a system.

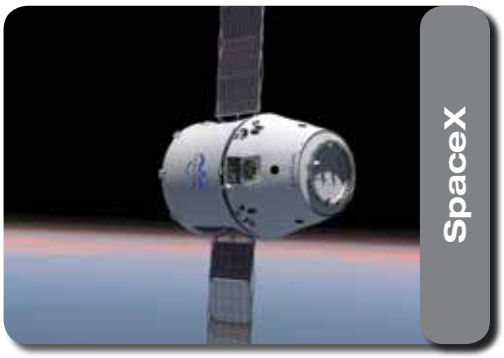
The goal of CCP is to drive down the enormous cost of space travel by allowing aerospace companies the freedom to let technological ingenuity flourish in developing and demonstrating space transportation capabilities. NASA's technical expertise and resources will be accessible to companies from concept to implementation, balancing industry's own innovative capabilities with the agency's five decades of human spaceflight experience. In order to operate in this new fashion, the program drafted a Procurement System Review (PSR) in 2011 to identify the insight and oversight approach it will take with providers.

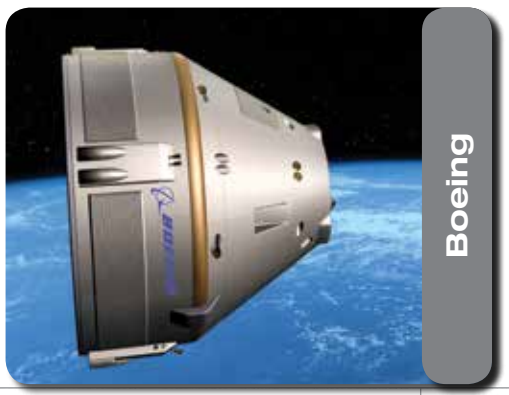
NASA tasked industry providers in September 2011 to deliver four astronauts and their equipment to the International Space Station and return them to Earth at least twice a year. A provider also must assure a crew's safety in the event of an emergency at the pad and during launch and ascent. The chosen spacecraft also must demonstrate it can serve as a 24-hour safe haven during an emergency in space and be able to stay docked to the station for at least 210 days.

CCP also introduced another partnership in FY11. In October 2010, the Federal Aviation Administration (FAA) set up shop at Kennedy to provide training in commercial space statutes, regulations, licensing processes, safety reviews and range integration.

The long-term goal of that partnership is to eventually license space transportation systems to provide flights much like an airline is licensed to fly planes around the globe. This could lead to NASA buying a transportation service to low Earth orbit in order for the agency to focus on what it takes to get to destinations in deep space, such as Mars or asteroids. It also could open up the market for other scientists, engineers and teachers who want to perform research and experiments in the weightlessness of space and could spur a future space tourism industry as well.

The next step for CCP will be to award competitive Space Act Agreements in 2012 for integrated design capabilities, under a phase called CCiCap. Those would be followed by a competitively awarded contract for a certification phase, which will ensure that a design fully meets the safety and performance requirements for a NASA mission. ■





Ground Systems Development & Operations Program

During Fiscal Year 2011, the Constellation Ground Operations Project transitioned into the Ground Systems Development and Operations Program (formerly the 21st Century Ground Systems Program) at Kennedy, making significant progress toward enabling a variety of future spaceflight endeavors. The advent of the new program helps usher in the major transformation of the center into a multi-user spaceport that is capable of supporting a broad range of government and commercial space and launch activities.

The program's mission is to be a driving force that transforms Kennedy into the world's premier multi-user launch and landing spaceport. The transformation, now under way, involves facilities, capabilities and spacecraft ground support equipment, as well as a re-engineering of management and business systems.

The program is leading Kennedy's physical transformation in support of the new Space Launch System, or SLS. Announced this year, the SLS is designed to be the most powerful U.S. rocket since the Saturn V took astronauts to the moon in 1969. The SLS Program, along with support from other NASA centers, will serve as the cornerstone for NASA's future in human space exploration.

To support the SLS vehicle, the crawler-transporter, Vehicle Assembly Building, Launch Pad 39B, the Launch Control Center's Young-Crippen Firing Room, and the new mobile launcher are being prepared for their new roles in support of human space exploration.

The Orion multi-purpose crew vehicle that will carry

Two 5.5-million-pound crawler-transporters await the opportunity to support NASA's future spaceflight programs. The crawlers originally were built to support the Saturn rockets for NASA's Apollo lunar landing program.

The mobile launcher, or ML, stands at Launch Pad 39B on Nov. 28, 2011. Data on the ML will be collected from structural and functional engineering tests and used for the next phases of construction overseen by NASA's Ground Systems Development and Operations Program.

astronauts aboard the SLS will be processed in Kennedy's refurbished Operations and Checkout (O&C) Building. Hardware for the Orion test article, called EFT-1, already is being built and is scheduled to start arriving at Kennedy in early 2012. The state of Florida previously provided $35 million for refurbishment of the O&C high bay, and the facility is fully operational and certified for Orion final assembly and checkout.

The most visible transformation among Kennedy's facilities has been at Launch Pad 39B, where the infrastructure and equipment unique to the space shuttle have been removed. Pad B will provide all the fluids, electrical and communications services to the SLS mobile launcher. The pad's generic infrastructure and equipment are being modernized and refurbished, paving the way for a launch pad capable of supporting multiple launch vehicles.

Kennedy has a 50-year history serving as our nation's gateway to exploring the universe. Taking the knowledge and assets of our successful space history, the Ground Systems Development and Operations Program arrived at year end with a vision of launching the world's most powerful, advanced launch vehicles and spacecraft. ■

In the Multi-Payload Processing Facility, NASA astronauts Shane Kimbrough, left, and Marsha Ivins, participated in a crew egress evaluation from an Orion mock-up Oct. 14, 2010. The exercise focused on whether astronauts and their rescue crews could exit the vehicle quickly in the event of a pad emergency.

Center Planning & Development

Kennedy Space Center has made significant strides this year towards becoming a multiuser launch complex serving both government and commercial space industry. The future will see a diversity of launch systems being accommodated at Kennedy, including orbital and suborbital flights. To accomplish that vision, the Center Planning and Development Office (CPDO) continued throughout the year to work with the nation's space launch industry on transforming the center and enabling the provision of services to government and commercial users.

In January 2011, CPDO released a formal Notice of Availability (NOA) and Request for Information to identify potential industry interest for space processing and support facilities at Kennedy that are currently or may become underutilized as a result of the transition from the Space Shuttle Program to future mission activities. Thirty responses were received and evaluated from the NOA to identify opportunities to repurpose Kennedy facilities to support the commercial space industry.

Kennedy Space Center Director Bob Cabana, left, Mark Sirangelo, head of Sierra Nevada Space Systems of Sparks, Nev., and NASA Administrator Charlie Bolden pose for a photo after signing a Space Act Agreement July 7, 2011, that will offer the company technical capabilities from Kennedy's uniquely skilled workforce.

Throughout FY2011, the center developed partnership agreements with the growing U.S. commercial space industry to support its development and operations. Among the companies with which Kennedy is actively working are Sierra Nevada Corp. (SNC) of Sparks, Nev., KT Engineering of Rancho Dominguez, Calif., Space Florida of Cape Canaveral, Fla., Orbital Sciences Corp. of Dulles, Va., and Space Exploration Technologies Corp. (SpaceX) of Hawthorne, Calif.

On July 7, 2011, Kennedy and SNC, which is developing a reusable spacecraft, the Dream Chaser, entered into a Space Act Agreement (SAA) for the company to use Kennedy's unique engineering expertise, facilities and services to develop commercial space systems. SNC is evaluating the feasibility of operating at Kennedy for future commercial crew launch services and other lines of space-related business.

In September 2011, an Umbrella SAA was signed between Kennedy and KT Engineering that will help the agency acquire the knowledge necessary to develop a multiuser ground system architecture for launching nontraditional, low-cost vehicles. One of these low-cost vehicles possibly being developed is KT Engineering's Radially Segmented Launch Vehicle that has the potential to be processed and launched from Kennedy.

Through a historic facility use agreement, Kennedy negotiated with Space Florida, the aerospace economic development agency of the state of Florida, to exclusively occupy, use and modify Orbiter Processing Facility-3, the Space Shuttle Main Engine Processing Facility and the Processing Control Center for a 15-year term. Space Florida is leasing the facilities to The Boeing Company to manufacture and test the company's Crew Space Transportation (CST-100) spacecraft and to provide mission operations, training and program offices. This effort is expected to create up to 550 jobs for the Space Coast by 2015. Boeing recently announced it is locating its Commercial Crew

In the Orbiter Processing Facility-3 (OPF-3), Gov. Rick Scott speaks to the audience during a ceremony Oct. 31, 2011, announcing the signing of an innovative agreement between NASA and Space Florida. NASA announced a partnership with Space Florida to occupy, use and modify OPF-3, the Space Shuttle Main Engine Processing Facility and Processing Control Center.

program headquarters at Kennedy.

Kennedy and Orbital Sciences Corp. signed an agreement providing access to the center's facilities and support services. Kennedy signed an additional agreement with SpaceX to use certain buildings and land. Several companies also have entered into agreements with Kennedy to use the Shuttle Landing Facility for testing purposes.

Early in 2011, at the Exploration Park site, crews began clearing land and preparing for the construction of a new connector road that will enable commercial access to the existing Space Life Sciences Laboratory (SLSL), making it the cornerstone facility of the park. Exploration Park's initial 60-acre phase, located just outside the security gates of Kennedy, will accommodate about 350,000 square feet of planned office, research, lab and light manufacturing space with high bay capability in up to nine separate LEED-certified buildings. Space Florida is actively engaged in discussions with a number of potential tenants as they prepare the site for the start of vertical construction in FY2012.

A NASA cooperative agreement was awarded to the Center for Advancement of Science in Space (CASIS) in September 2011. The SLSL is the new home to the organization that will manage the portion of the International Space Station that is operated as a U.S. national laboratory. The independent, nonprofit, research management organization will help ensure the space station's unique capabilities are made available to the broadest cross section of U.S. scientific, technological and industrial communities.

During FY2011, the CPDO's staff of partnership developers and spaceport planners engaged in direct discussions with more than 80 potential industry partners regarding their company-specific needs and requirements that might be met by utilizing the center's unique facilities and capabilities. By year-end, CPDO had obtained more than 15 additional agreements. ■

Engineering & Technology

Research and innovation flourish in Kennedy Space Center's Engineering and Technology Directorate, which continues to drive development of technologies and procedures critical to future human space exploration.

A state-of-the-art lightning detection system went to work at Kennedy's Launch Complex 39B during the fiscal year. The system can determine the location of direct strikes at an accuracy of no more than two meters, and nearby strikes at five meters or better. In addition to high-speed video of lightning incidents, the system takes direct measurements of incident currents and estimates magnitudes and rise times of currents and electromagnetic fields of direct and nearby strikes.

A Tilt-Up Umbilical Arm was manufactured and delivered to the Launch Equipment Test Facility (LETF) at Kennedy. The umbilical arm is used to provide fuel and communication to a vehicle at the launch pad. The arm will undergo testing at the LETF and will be the first test article using the newly-installed Vehicle Motion Simulator. This testing will help to validate computer models used during design, and the test results will help to improve umbilical designs for the agency's new Space Launch Systems vehicle.

The linear-mate ground carrier plate and electric solenoid-actuated collet are two key mechanisms developed by Kennedy engineers which may be used on NASA's new Space Launch System vehicle. The umbilical plate is a unique, two-piece design with an outer plate that is aligned and locked to the vehicle. An inner plate translates to engage the commodity connectors. The collet can be unlocked without the use of a pyrotechnic device, which represents a huge operational and cost benefit.

Kennedy engineers designed a cold helium heat exchanger which was fabricated by Eden Cryogenics in Plain City, Ohio, and delivered to Kennedy during the fiscal year. The exchanger provides three circuits of gaseous helium colder than -360 degrees F and will be used to support future programs that use the J-2X engine. It was originally designed for use in the Ares I upper stage for liquid oxygen pre-press, liquid hydrogen pre-press and cold helium bottle fill, each with unique flow rates and temperature requirements.

The NASA payload is installed on the prototype rover Artemis Jr. for the Regolith and Environment Science and Oxygen and Lunar Volatile Extraction, or RESOLVE, project in a test facility behind the Operations and Checkout Building.

The heat exchanger was then shipped to Marshall Space Flight Center in Huntsville, Ala., for full-scale hydrogen testing during the summer of 2011. The test results revealed that the outlet temperature requirements were exceeded by margins of 10 to 15 percent. The testing anchored the heat transfer models used in design and will enable the design team to meet future cold helium requirements with a more efficient, compact design.

Kennedy's Engineering and Technology Directorate received 78 awards, representing approximately $50,000 in dollar value, and earned 28 Tech Brief

Awards, 18 Software Release Awards, 16 Patent Application Awards and 16 Board Action Awards.

One significant award went to the Launch Reliable Ground Coolant System, which increased reliability in the highly critical ground cooling unit that removed heat from the orbiter's onboard avionics. The original ground cooling unit, in place since the advent of the Space Shuttle Program, had difficulty handling the variety of heat loads it frequently encountered throughout the course of a countdown. Redesigned based on a constant heat load, the new technology provided a simple and reliable refrigeration system capable of accommodating load variations. The improved system was highly economical for use in space shuttle launch preparations, where maximum reliability was essential.

Another project to receive an award is the Wireless Orbiter Hang Angle Instrumentation System. This high-precision, wireless inclinometer was designed to monitor the suspension angle of the orbiter while it hung inside the Vehicle Assembly Building, awaiting attachment to the external tank and solid rocket boosters. Previously, the orbiter's hang angle was measured manually using a hand-held inclinometer. The new wireless inclinometer was attached to a plumb reference point outfitted with a wireless interface, ensuring consistent, accurate measurements that could be repeated throughout the operation while eliminating hazardous elements.

Technology

The Forward Osmosis Bag (FOB) is a portable water-purification system designed to recycle wastewater by forcing it through a semipermeable membrane that blocks impurities, resulting in safe, drinkable water. The technology was tested on STS-135, the final flight of the Space Shuttle Program. Mission Specialist Rex Walheim performed the experiment, in which six FOB kits plus one spare were filled on one side with artificial wastewater containing blue dye and a salt solution, and filled on the other side with a fluorescent-dyed sugar solution. Post-flight analysis showed the bag was nearly as effective in space as on Earth. The FOB design tested in space was based on the X-Pack™, a commercial product manufactured by Hydration Technology Innovations of Albany, Ore., and tested first at NASA Ames and at Kennedy.

A member of NASA's Desert Research and Technology Studies (RATS) mission performs EVA geology while attached to the Astronaut Positioning System, Aug. 30, 2011, in the desert near Flagstaff, Ariz.

Another project is the Regolith and Environment Science & Oxygen and Lunar Volatile Extraction (RESOLVE) for Robotic Lunar Lander Mission. The second of two Advanced Exploration Systems projects at Kennedy, RESOLVE is now is in its third generation. This miniature drilling and chemistry laboratory can be included on a lunar rover, enabling it to collect and analyze soil in a hunt for volatile components such as hydrogen or water. The goal is to search for these components below the moon's surface as a payload on a future lunar lander. The technology will be field-tested in July 2012 in Apollo Valley at Mauna Kea, Hawaii.

NASA's Desert Research and Technology Studies (Desert RATS) is an agencywide effort to demonstrate emerging technologies in an analog environment. This year marked the testing of the first prototype of a Deep Space Habitat that can be configured for the microgravity of surface exploration missions. Kennedy contributed several systems to the project, including communications equipment, solid-state lighting, a deployable work platform, and general maintenance workstation. The space center also provided demonstrations of space-based food production, dust-mitigation systems and damage-detection systems.

These and many other Kennedy engineering and technology accomplishments have contributed to the center's efforts to prepare for NASA's future space exploration programs. ■

Environmental Leadership

Kennedy Space Center remained in the forefront of environmental leadership during FY 2011 with its ongoing commitment to preserve and protect the environment.

In line with the federal government's mandate and NASA's Strategic Sustainability Performance Plan, the center created its first-ever Sustainability Plan which includes hundreds of ways to reduce its footprint and conserve the environment inside Kennedy's gates.

Some of the sustainability goals include reducing greenhouse gas emissions; designing and building sustainable buildings, facilities and infrastructure; conserving and managing water resources; minimizing waste and preventing pollution; purchasing sustainable products and services; managing electronic equipment and data centers responsibly; and integrating sustainability into local and regional planning.

Kennedy and the Medical and Environmental Support Contractor (MESC) received the U.S. Fish and Wildlife Regional Directors Conservation Award for 2011 for its outstanding contributions to the rescue of hundreds of sea turtles from across the state of Florida during the 2010 freeze that hit Central Florida during the winter months.

Kennedy and MESC also participated in the Deep Water Horizon oil spill recovery by assisting the National Marine Fisheries, U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission in relocating sea turtle eggs from the Florida panhandle area shoreline to an incubation facility set up at Kennedy. The eggs were allowed to hatch and released along the Kennedy shoreline. Kennedy provides a vitally important nesting habitat for several species of endangered sea turtles.

The center continued its robust environmental remediation program to identify and clean up environmental contamination from past actions which occurred before the environmental harm from these actions was known. Kennedy's environmental remediation actions this year removed more than 1,139 tons of soil contaminated with chlorinated compounds, such as polychlorinated biphenyls, and cleaned up 936,000 gallons of groundwater contaminated with volatile organic compounds.

The center incorporated wetlands restoration into a project to stabilize the shoreline along the

On Jan. 5, 2011, an endangered green sea turtle is released into the Mosquito Lagoon, which is part of Florida's Indian River. Workers with NASA's Kennedy Space Center, Innovative Health Applications and the Fish and Wildlife Conservation Commission rescued more than 300 turtles during the winter's frigid temperatures.

The new environmentally friendly Propellants North Administration and Maintenance Facility was completed and opened in January 2011.

NASA causeway revetment. After the shoreline stabilization was complete, Kennedy took advantage of this project to restore a wetlands area along the shoreline, thereby creating a new habitat within Kennedy's boundaries.

In order to protect valuable launch assets, Kennedy partnered with the U. S. Air Force 45th Space Wing to create a secondary sand dune near Launch Complex 39, an area subject to severe erosion from storms and other natural processes. Excess sand donated by the Space Wing was used to construct the secondary dune. Besides protecting valuable assets from erosion, the cooperation had an important additional benefit of expanding the available habitat of endangered sea turtles, gopher tortoises, and other threatened and endangered species.

Kennedy expanded its waste diversion and recycling programs in 2011. More than half of all waste collected at Kennedy was diverted for reuse and recycling. Materials diverted from landfill disposal and reutilized for other purposes included about 10,000 tons of concrete from construction projects, about 2,900 tons of crawlerway rocks, 1,156 tons of scrap metals, and 800,000 pounds of paper and cardboard.

Another example of reutilization was Kennedy's transfer of five excess rocket motors to NASA's Jet Propulsion Laboratory to support testing in NASA's Radioisotope Power Systems Program. This reutilization saved Kennedy about $150,000 in disposal costs and saved NASA more than $1 million that would have been required to buy new motors for this test.

After the final successful space shuttle mission in July and the downsizing of Kennedy's workforce which followed, Kennedy's Environmental Program collected about 346,000 excess office supply items, with a combined total value of nearly $115,000, that were no longer needed on center and donated them to local schools for their use.

A 1 megawatt (MW) solar power generation facility constructed by Florida Power and Light Co. at Kennedy provides power back to the center. This facility saves Kennedy more than $154,000 in energy costs and reduces greenhouse gas production by more than 1,000 tons annually. ■

Education

Kennedy Space Center's Education Office ventured into nearby communities with great success during 2011. By partnering with the center's scientists, researchers and engineers, Kennedy was able to inspire students in their classrooms and through successful workshops, competitions and other goal-centered events held on center, reaffirming their commitment to NASA's initiative to interest students in the science, technology, engineering and mathematics, or STEM, disciplines.

Kennedy's K-12 program conducted workshops that reached more than 70,000 students and educators in 2011, far above the goal for the program. The Educator Resource Center, Aerospace Education Service Project and Digital Learning Network (DLN) engaged in this effort to expand NASA's contact with those in the education field. Kennedy Director and former astronaut Bob Cabana lent his personal support to several sessions of the DLN by discussing science and his spaceflight experiences with students.

Local and Partnership Initiatives:

- NASA Kennedy CubeSat pilot project: This initiative enables local high school students to design, build, test and potentially launch a small satellite. A Space Act Agreement was signed this year with Brevard Public Schools to work with students from Merritt Island High School. NASA mentors and students work together in teams structured in accordance with the work breakdown for a small satellite project. Projects focused on areas such as project management, payload and spacecraft systems design and development, systems engineering, and safety and mission assurance. The students participated in all phases of the mission life cycle and presented their projects to a board of NASA engineers during the required reviews.
- Brevard Learns About Science and Technology (BLAST): Kennedy partnered with the Brevard County Public Schools and Delaware North Companies Parks and Resorts education department to provide every seventh-grader attending Brevard County Public Schools the opportunity over a 51-day period to experience the Kennedy Space Center Visitor Complex and participate in STEM learning activities.
- NASA Days at Florida Agricultural and Mechanical University (FAMU): NASA managers attended briefings and a tour of the

At the Astronaut Hall of Fame near the Kennedy Space Center Visitor Complex in Florida, fifth- through eighth-grade students and their parents create lava lamps and slime in a fluids experiment during a NASA family education night event, Aug. 28, 2010.

During the NASA Explorer Schools Symposium at Kennedy Space Center in Florida, students and teachers tour the U.S. Astronaut Hall of Fame on May 5, 2011.

campus thereby gaining insight into FAMU's technologies and FAMU students' capabilities. The participating students received SOLAR and Resumix workshops, interacted with senior managers and were interviewed for possible future intern and co-op positions at NASA centers across the country.

- Florida Space Day: The Education Office held workshops at the Developmental Research K-12 public school, located on the FAMU campus. About 350 students participated in STEM-related hands-on activities and workshops.
- Kennedy's Fall Festival: About 1,200 people took part in Kennedy's Education outreach activities, some of which were named "Straw Rocket," "Shuttle Glider," "Stomp Rocket," "Gee Whiz" presentations and edible "Comet on a Stick" to appeal to participants of all ages.
- Saturday Academy: A partnership with Boys & Girls Clubs of Brevard enabled children from two local clubs to attend hands-on STEM workshops one weekend a month for eleven months. This initiative also included workshops for their parents and guardians.
- Physics Day with Busch Gardens: Kennedy's Digital Learning Network hosted a show in front of a live audience at Busch Gardens which reached about 2,280 attendees. It included a variety of experiments and demonstrations involving physics principles.
- Educator Appreciation Day: In partnership with Delaware North, 68 educators participated in NASA STEM-based workshops, receiving Launch Services Program and general NASA information and educational materials, and enjoyed access to the Kennedy Space Center Visitor Complex, the Astronaut Hall of Fame and the "Cape Canaveral: Then and Now" bus tour.
- Teaching from Space Initiative Joining Forces: More than 800 students and 50 teachers, from six different bases in the Kennedy region of Florida, Georgia and Puerto Rico, participated in workshops designed to engage students in activities to increase their interest in STEM careers; facilitate interaction with NASA engineers, scientists and educators; provide hands-on experiences to promote STEM learning and increase awareness of NASA education programs.
- Minority Outreach in conjunction with Black

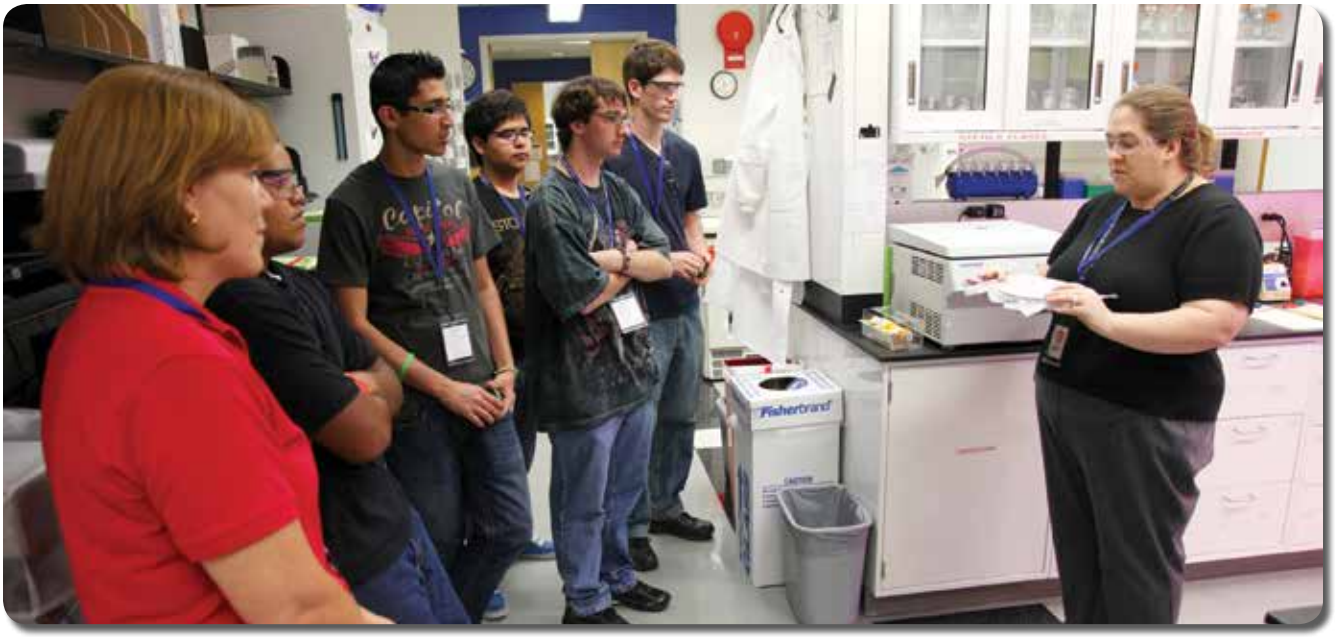
History Month: Various elementary and middle schools in St. Petersburg and Palm Beach were visited to encourage a targeted population of young black males to stay in school. This activity was in response to the Black Boys Report which identifies areas with the highest high school drop-out rates amongst African-American males. Florida holds four of the top ten spots. Students participated in a hands-on STEM-related activity, and NASA engineers shared their experiences with students.

- NASA's Summer of Innovation (SoI): This national initiative reached thousands of students, with Kennedy's work accounting for some 1,700 students through six Kennedy collaborations, including "Girls Get IT Surf and Science Camp," and events with schools as far away as the U.S. Virgin Islands Math, Engineering, Science, Achievement (MESA), and the Fernbank Science Center in Atlanta. Kennedy also supported eight national SoI awardees, reaching about 2,500 students and 150 educators at each event.
- Minority Student Education Forum: Kennedy and Glenn Research Center in Cleveland, Ohio, co-sponsored a minority student education forum for more than 375 fifth- through twelfth-grade students. The event provided real-world experiences and examples to encourage them to become scientists and engineers of the future. Designed to motivate minority students to purse STEM careers, forum highlights included a panel of some of NASA's most notable past and current senior managers, peer-to-peer ambassador roundtable discussions, hands-on educational activities, and a robotics demonstration.
- Kennedy also lent support for some unusual displays of pride in the American space program in 2011. For example, when the Rock Ranch in Thomaston, Ga., created a corn maze by carving a spaceman in an EVA suit into their cornfield to celebrate 50 years of human spaceflight, Kennedy supported the event with displays, hands-on activities and planetarium shows and interacted with about 1,500 people over two days.

Competitions:

- In the second annual Lunabotics competition, held at the Kennedy Space Center Visitor Complex, students designed and built remote-controlled or autonomous excavators, called "lunabots," that could collect and deposit a minimum of 10 kilograms of simulated lunar material within 15 minutes. The number of teams applying to enter the competition tripled from 2010, and 36 teams from universities around the world competed. Thirty of the teams were from the United States.
- The 2011 Waste Limitation Management Recycling (WLMR) Challenge winners were a group of girls from Hudson Middle School in Wisconsin, selected from a group of 25 teams who submitted a final design. The challenge called for the team to work together to create, build and test innovative water treatment strategies that can operate for long periods of

University students prepare for NASA's second annual Lunabotics Mining Competition at the Kennedy Space Center Visitor Complex in Florida on May 23, 2011. The competition was held May 26-28 and included 36 teams from the United States, Bangladesh, Canada, Columbia and India.



Students listen intently as a laboratory technician describes a research project in Kennedy Space Center's Space Life Sciences laboratory May 12, 2011. High school students from two Orlando, Fla., schools traveled to Kennedy to participate in National Lab Day activities.

time in space environments.

- The Planetary Lander Egg Drop Competition took place at Universal Studios in Orlando and presented STEM hands-on activities for about 250 students.
- In celebration of the 50th Anniversary of Human Space Flight, Kennedy hosted a student competition open to all Brevard County Schools. The winning team was Palm Bay Community Charter School. The award included a visit by astronaut Leland Melvin who presented the Junior Space Club's 10-member team with a bound and framed book on future space life.
- The For Inspiration and Recognition of Science and Technology (FIRST) robotics Pink Team, one of Kennedy's "house teams," won the regional competition in Washington, D.C., and participated in the national competition. The Pink Team was approached by the Secret Service to work on a special project for them after seeing the robot the group built for the Rockledge Police Department.

NASA Agencywide Initiatives:

Kennedy Space Center's Education Office managed several agency programs in Fiscal Year 2011 to support NASA's expanding education initiatives. These included the Exploration Systems Mission Directorate (ESMD) Space Grant Project, the Interdisciplinary National Science Project Incorporating Research and Education (INSPIRE) Experience, the Experiment Program to Stimulate Competitive Research (EPSCoR), and the Minority University Research and Education Program (MUREP) Small Project Grantees.

ESMD Highlights:

- The ESMD Space Grant Project hosted Senior Design Training for 28 faculty covering the newly developed and tested senior design course "Habitats in Extreme Environments," as well as additional topics such as the NASA Systems Engineering Process and Senior Design Projects.
- ESMD Faculty Fellowships: Four faculty fellows worked at a NASA center to become technical experts on a NASA project. They also learned about systems engineering and how to apply that approach to a senior design project.
- Industry Interns: Sixty-two student interns were placed with industry thanks to funding from the ESMD supplemented by the industry partners.
- Systems Engineering Paper Competition: In its fifth year, 12 teams entered the competition and wrote about using the NASA systems engineering process for their senior design projects. The papers were judged by systems

To celebrate NASA's 50 years of spaceflight, the owners of the Rock Ranch in Thomaston, Ga., created a corn maze by carving a spaceman in an EVA suit into their cornfield.

engineers across the agency.

- First Nations Rocket Competition: Five engineering teams of Native American students competed in the rocket competition in Wisconsin. A Kennedy engineer supported the competition as a judge and mentor.
- Women in Engineering: Six women at the Montana State University designed and built a device to allow broken circuits to repair themselves on orbit. The technology will be tested aboard a high-altitude balloon, and the data will be shared with Marshall Space Flight Center in Huntsville, Ala., and the Department of Defense.

INSPIRE Highlights:

INSPIRE is a research-based, multi-tiered student pipeline program designed for high school students. It provides a vital link between NASA's elementary/secondary projects and higher education projects. The scope and purpose of INSPIRE emphasizes the recruiting of underserved and underrepresented students to ensure a diverse pool of candidates from throughout the U.S. Students selected to participate learn about STEM fields of study and careers; participate in the INSPIRE Online Learning Community (OLC); and compete for unique, grade-appropriate summer experiences at a NASA facility.

NASA's unique mission provides the content for the OLC, the centerpiece of INSPIRE. It provides a virtual place for INSPIRE students to interact with their peers, NASA experts and education specialists. Through grade-appropriate educational activities, chats and discussion boards, students and their families are exposed to the many careers and opportunities at NASA. The OLC also provides parents and caregivers resources designed to help them champion their student's education and career goals.

EPSCoR Highlights:

EPSCoR is designed to assist states in establishing an academic research enterprise directed toward a long-term, self-sustaining and competitive capability that will contribute to the states' economic viability and development, and to develop partnerships between NASA research assets, academic institutions and industry. Through a merit-based, peer-reviewed competitive process, EPSCoR awarded $19.9 million to 27 institutions.

MUREP Highlights:

MUREP Small Projects funded the Minority Innovation Challenges Institute (MICI) which is managed by FAMU. This innovative project is based on historical evidence of extremely low participation of minority-serving institutions in NASA challenges. In less than two years, MICI has been able to implement a significant change in this critical metric. In 2011, MICI selected 10 minority-serving institutions to receive grants of $4,000 each to participate in NASA university challenges. These grantees are in the categories of Hispanic Serving Institutions, Historically Black Colleges and Universities, and Tribal Colleges and Universities. ■

Two white ibises stand parallel at the edge of a pond at Kennedy Space Center in Florida on Dec. 19, 2011.

Outreach to the World

Kennedy Space Center's goals and accomplishments grabbed the world's attention in 2011, as the space agency's primary launch site celebrated the final missions of the space shuttle fleet and extended humanity's knowledge of the solar system by dispatching new probes and observatories on groundbreaking missions.

A host of Kennedy employees highlighted the work by reaching out to people across America and around the world through the Internet and speaking engagements and by briefing individual legislators on what NASA does and how Kennedy's work plays a central role in the agency's success.

Locations around Kennedy Space Center were temporarily turned into a Hollywood studio Oct. 1-8, 2010, as film director Michael Bay shot scenes for the movie "Transformers 3." Many Kennedy employees served as extras to give the movie a sense of authenticity.

Kennedy Web Presence

The Kennedy Space Center website continued to draw a worldwide audience. The center's website at www.nasa.gov/kennedy attracted close to 35 million views this past year. The Kennedy Web team also oversaw the shuttle section for the agency, www.nasa.gov/shuttle, which received more than 59 million views. Both sites consistently ranked in the top 10 most-popular pages within the NASA Web portal at www.nasa.gov.

Kennedy's social media presence, under the username NASAKennedy, became the stalwart for many to find the latest news from the space center, increasing the fan base to more than 150,000 friends on Facebook and about 269,000 followers on Twitter. The NASAKennedy YouTube channel climbed to more than 20,000 subscribers with more than 1.8 million video views.

During the year, the Web team provided launch processing and countdown coverage for the final three space shuttle flights and five expendable launch vehicle missions. An international Internet audience was kept up to date during countdowns and landings with frequent updates to the mission's main page and to its photo and video galleries. NASA's Launch Blog provided live commentary and up-to-the-minute information straight from a control room console to the reader. Kennedy's Web video products included feature videos and podcasts, as well as highlights of launches and landings.

News Media Operations

News media representatives from the U.S. and around the world, as well as hundreds of Tweeters, were provided with timely and accurate information about NASA's last three space shuttle missions and expendable launch vehicle launches, special events and other center activities. Information was channeled via live and taped interviews, news conferences, media updates, printed fact sheets and newsletters, exhibits and social media outlets, including websites, blogs and Twitter updates. Other avenues of communication included Kennedy's high-

Kennedy Space Center employees gathered around characters from the "Transformers 3" movie, including Optimus Prime and Bumblebee, outside the Kennedy Space Center Visitor Complex on Oct. 10, 2010. Paramount Pictures filmed scenes for the movie at Kennedy from Oct. 1 through 8.

Members of the media gather near the countdown clock to see the rocket's red glare for the last time as space shuttle Atlantis roars off Launch Pad 39A at 11:29 a.m. EDT on July 8, 2011, on the STS-135 mission to the International Space Station. It was the final mission of Atlantis and the 135th and final mission of the agency's Space Shuttle Program.

definition NASA TV broadcasting; streaming video of Kennedy events; digital imagery on the multimedia gallery, at http://mediaarchive.ksc.nasa.gov, which received more than 8.5 million page views in Fiscal Year 2011; and a full-service office catering to professional journalists. Video news releases, still photographs, video footage, tapes, CDs and DVDs were distributed to media outlets.

Kennedy Space Center Visitor Complex

Perhaps nowhere was Kennedy's story better told to the public at large than through the Kennedy Space Center Visitor Complex (KSCVC). NASA works closely with the visitor complex operator, Delaware North Companies Parks and Resorts, to share stories and artifacts that appeal to a broad range of people from around the world.

More than 1.4 million guests visited the complex in 2011. The center reached a national and global audience through a combination of exhibits, space artifacts, IMAX films and tours of Kennedy's historic grounds.

The year will be best remembered for the space shuttle. Thousands of visitors watched the final launches of the program through the services provided by the visitor complex. The Kennedy community and the nation found out April 12 that Kennedy Space Center would be the permanent home of shuttle Atlantis. A new exhibit for the shuttle will be constructed to display the historic spacecraft in unprecedented ways.

Delaware North continued to make progress on its 10-Year Master Plan and completed designs for several large projects. Along with building a new home for Atlantis, the center began the work to reorient the main entrance to feature the historic and iconic Rocket Garden and redesign the LC-39 Observation Gantry Tour Stop.

The demand for launch viewing opportunities through the complex grew significantly as the final launches of the Space Shuttle Program were successfully completed.

Immediately following the historic final mission of the shuttle, STS-135, in July, exciting launches to explore our Solar System aboard expendable launch vehicles from Cape Canaveral followed, including Juno, GRAIL and the Mars Science Laboratory.

The complex collaborated with several partners to plan and deliver exciting events to engage the public featuring the U.S. Postal Service's first-day-of-issue ceremony for the Project Mercury and MESSENGER stamps, the 50th anniversary of U.S. spaceflight and induction of the tenth group of Space Shuttle Program astronauts into the U.S. Astronaut Hall of Fame. Karol J. "Bo" Bobko and Susan J. Helms joined the family of American space heroes during a weekend of inspiring events in May.

Thousands of space shuttle workers and their families gathered near the Rocket Garden at the Kennedy Space Center Visitor Complex in Florida for the "We Made History!" Shuttle Program Celebration, on Aug. 13, 2011. The event was held to honor current and former workers' dedication to NASA's Space Shuttle Program and to celebrate 30 years of space shuttle achievements.

The summer season offered exciting events and programs, including the support of the second Lunabotics Mining Competition held at the KSCVC main campus and launch of Sci-Fi Summer where science fiction meets science fact.

In collaboration with the Astronaut Scholarship Foundation, the 40th anniversaries of Apollo 14 and Apollo 15 were honored with festivities at the visitor complex.

The "KSC Up-Close" Special Interest Tour once again offered a tour of the Vehicle Assembly Building featuring the opportunity to go inside the iconic facility and get close to one of the flown space shuttles being processed for permanent display.

As part of its community outreach program, the visitor complex sponsored the Cocoa Beach Fireworks Show on Independence Day. Other activities hosted at the visitor complex included "We Made History," a pride-filled celebration honoring the end of the Space Shuttle Program.

The visitor complex continued to successfully operate two retail stores in the Orlando International Airport and offered a variety of robust educational programs geared toward inspiring the next generation of explorers. More than 84,000 students participated in Camp KSC, Overnight Adventures and the Astronaut Training Experience. For more than 45 years, the visitor complex has operated as a self-supporting entity funded solely through revenues earned through admission, retail and food sales.

Government Relations

Elected officials from federal, state and local levels traveled to Kennedy to tour its grounds and facilities, and to learn more about the wide range of activities happening at the center in 2011. Kennedy also hosted a large number of elected officials for the last three shuttle launches and for two Launch Services Program launches: Juno and GRAIL.

The center's senior management team participated in numerous forums and meetings throughout Florida concerning the future of Kennedy and the space industry in Florida. During the year, Deputy Center Director Janet Petro spoke before the Brevard State Delegation at their annual meeting, to the Florida Senate Committee on Military Affairs, Space and Domestic Security, and to the Space Florida Board of Directors.

Center Director Bob Cabana, senior management and industry representatives joined to visit with state legislators during Space Industry Day in the state's capital.

Cabana met with members of the Florida Congressional Delegation in Washington, D.C., in support of NASA's Office of Legislative and Intergovernmental Affairs' annual "Day on the Hill" event and detailed Kennedy's plans and activities to the Brevard legislative delegation.

Exhibits

During Fiscal Year 2011, the Display Management Team (DMT) supported 38 events with a total attendance of about 1.1 million, double the audience size from the previous year. The biggest event was the South Florida Fair, which took place in West Palm Beach. More than 500,000 people attended the event. Other events included Hennac, and the Pensacola Air Show.

By participating in more nontraditional events, such as home shows, sporting events and others, the team was able to educate the general public on contributions that the space industry has made to everyday life and how those contributions directly affect them.

Guest Operations

Kennedy's Guest Operations staff enabled more than 21,000 guests of NASA and its center partners to safely participate in behind-the-scenes Kennedy tours, including educational briefings provided by center engineers and operational experts.

As Kennedy successfully flew out the shuttle program, thousands of the agency's invited guests participated in launch briefings and viewing opportunities for the final three space shuttle flights. An increased effort was made to accommodate as many special guests as possible to witness these historic shuttle launches from Kennedy viewing sites.

Kennedy also held events for past and present employees to honor and recognize their great achievements during NASA's Space Shuttle Program era.

As the shuttle program ended, Guest Operations continued to inspire and engage the public by hosting nearly 25,000 guests for exciting Launch Services Program science missions. Launches of Juno, Gravity Recovery and Interior Laboratory (GRAIL), and the Mars Science Laboratory (MSL), with the Curiosity rover, were viewed by members of Congress, business and agency leaders, astronaut families, medical and legal professionals, veterans, teachers and students.

Speakers Bureau

Kennedy's extensive network of professional engineers, technicians and other experts in rocketry took part in the center's speakers program. In 2011, they attended more than 360 events throughout Florida, Georgia, Puerto Rico, and even as far away as South Africa and the Philippines. They reached more than 60,000 children and adults through career days, community events and professional talks.

Their presentations included hands-on activities in the science, technology, engineering and mathematics, or STEM, disciplines. ■

NASA Administrator Charlie Bolden speaks to about 150 followers of the agency's Twitter account during Juno Tweetup activities inside a tent at the Kennedy Space Center Press Site on Aug. 5, 2011.

Kennedy Business Report

Budget Highlights

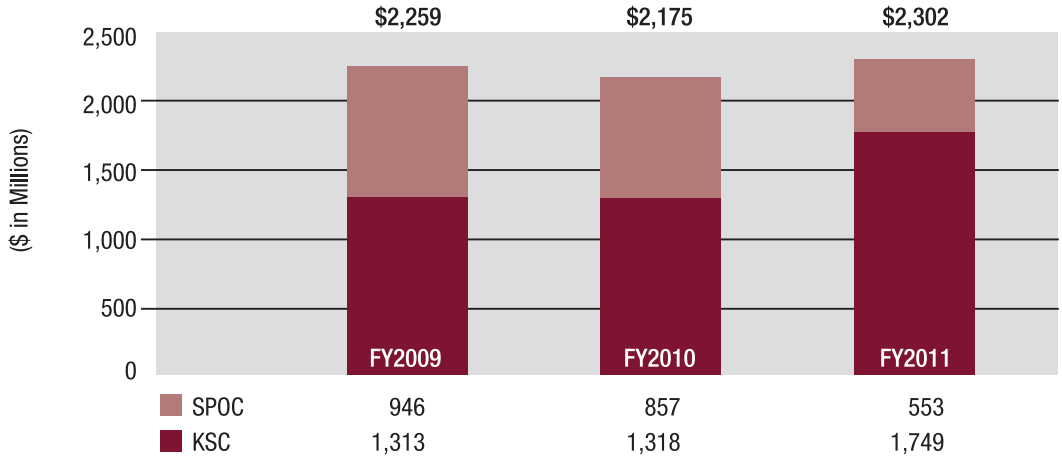
The Kennedy Space Center FY 2011 budget totaled nearly $1.7 billion and more than $2.3 billion when the Johnson Space Center-managed Space Program Operations Contract (SPOC) and related work performed at Kennedy was included. The center also performed $111 million in reimbursable work with other government and commercial entities.

- The Space Shuttle Program (including total SPOC impacts) executed a $714 million budget by accomplishing the final three shuttle missions during FY 2011, all of which carried major components or logistics to the International Space Station. The FY 2011 activity included two shuttle missions (STS-133 and STS-134) that slipped into FY 2011 from FY 2010. The STS-133 mission carried the fourth Express Logistics Carrier with spare parts for the station and also delivered the Permanent Multipurpose Module (PMM); STS-134 carried the Alpha Magnetic Spectrometer; and STS-135, the last shuttle mission, carried the Raffaello multipurpose logistics module with supplies to the space station.

- The International Space Station's $85 million budget allowed for the successful processing and launch of several station assembly and utilization missions. These consisted mainly of the following deliveries and hardware installations – two Express Logistics Carriers, the Permanent Multipurpose Module, the Alpha Magnetic Spectrometer, a multi-purpose logistics module, and ancillary supplies and equipment necessary to help operate and sustain the fully assembled space station.

- The Launch Services Program (LSP) executed a $483 million budget (direct and reimbursable). LSP supported three successful mission launches – Juno and Gravity Recovery and Interior Laboratory (GRAIL) from Cape Canaveral Air Force Station in Florida, and Aquarius/

NASA/KSC Budget Authority Summary FY 2009 through FY 2011 ($ in Millions)

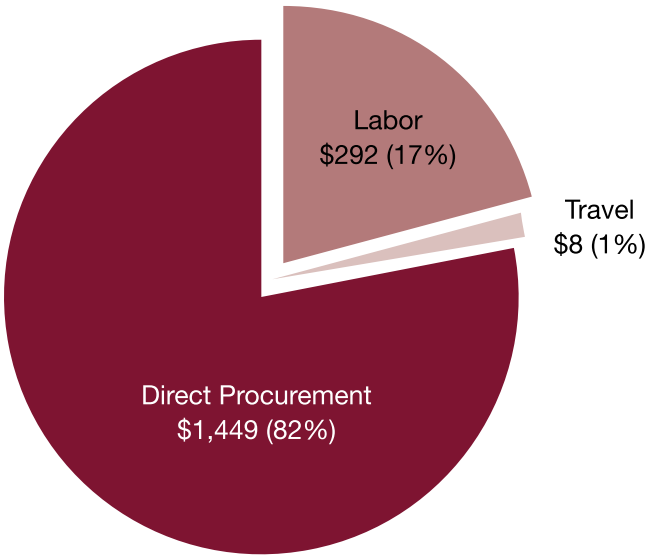


Kennedy Space Center
FY 2011 Budget Authority ($ in Millions)

Space Shuttle	$149
Space Station	$85
Launch Services/Science	$396
21st Century Ground Systems	$357
Center Management & Operations	$358
Other	$403
Total KSC*	$1,748

** Excludes Space Program Operations Contract (SPOC)*

FY 2011 KSC Budget by Elements
($ in Millions)



Eighty-two percent of the Kennedy budget is spent through the purchase of goods and services from commercial providers. The SPOC, or space shuttle contract, managed by Johnson Space Center in Houston is excluded here. Its inclusion would increase the percentage of procured services to 87 percent.

SAC-D from VAFB, Calif. The program also procured launch vehicle services and other support services for several manifested missions scheduled to launch in FY2012 and beyond.

- The Ground Systems and Operations Program budget of $357 million provided for the modernization and augmentation of current and future ground systems design, development, and ground operations infrastructure in order to facilitate the activities of future customers and stakeholders in NASA's Space Launch System and Orion Multipurpose Crew Vehicle. Other key projects included enhancements to the range, payload processing capabilities and environmental cleanup activities.

- Kennedy's Center Management and Operations budget provided $358 million in FY2011 to maintain the center's critical mission essential facility systems and life safety systems; core technical capabilities and supporting infrastructure; sustain the center's safety and engineering technical authorities; implement agency Chief Information Officer initiatives; and provide business systems support with improved internal controls.

Space shuttle Atlantis is slowly towed from the Shuttle Landing Facility (SLF) to an orbiter processing facility for the last time after touching down on July 21, 2011, at 5:57 a.m. The final mission, STS-135, brought a close to America's Space Shuttle Program. Hundreds of workers welcomed Atlantis home during an employee appreciation event.

Economic Impact

NASA's Kennedy Space Center remains a very significant economic driver in Brevard County and a major contributor to the economic health of the state of Florida. Analysis of the Fiscal Year 2011 expenditures concludes that overall NASA activities and ones specifically related to Kennedy across Florida contribute more than $1.7 billion in wages and purchases to the state economy. Economic models have estimated that both this direct spending, as well as the subsequent indirect income and job creation, results in a $3.7 billion total economic impact to Florida. This impact is created through employment of an estimated statewide, NASA-related workforce of 26,000, with wages of $1.9 billion in income, resulting in nearly $400 million in federal, state and local taxes. For each Kennedy job, an additional 1.25 jobs are supported in the secondary market throughout the state. NASA, Kennedy and Florida have a long-standing, demonstrated economic interdependence. In this post-shuttle era, Kennedy will continue to stimulate the economy with the additions of NASA's Exploration Ground Systems, Ground Systems Development and Operations Program and Commercial Crew Program, as well as with new space research, technology projects and the agency's Launch Services Program.

The Office of Personnel Management, NASA and Brevard Workforce hosted a job fair for former and current Kennedy Space Center aerospace workers, July 26, 2011, at the Radisson Resort at the Port in Cape Canaveral, Fla. More than 60 private industry employers and federal agencies were at the job fair attended by more than 1,000 job seekers.

Workforce Overview

Kennedy Space Center is the most broadly based, complex and successful launch center in the world. Both NASA and contractor personnel working at the center are essential to the success of Kennedy.

The workforce includes people with many skills who are dedicated to supporting the nation's space program and NASA's future explorations. To accomplish the agency's various missions, these individuals fulfill a multitude of tasks.

At the end of each year, the center takes a snapshot of its workforce. This picture includes all federal and contractor employees chartered to work for Kennedy. Other organizations, such as the European Space Agency and Patrick Air Force Base, have roles here but are not reflected in these numbers.

As of Sept. 30, 2011, the total Kennedy population was 9,011. This includes 2,096 NASA civil servants, 82 NASA students, 5,524 on-site and near-site contractor employees, 1,028 tenants and 184 construction employees on the center. There was a 43.8 percent decrease in the contractor workforce in FY2011. The civil servant skill mix includes scientific and engineering, administrative, technical and clerical workers.

Kenndy Space Center Workforce Profile (through 9/30/11)

Civil Servants	2,096
Co-ops and Students	82
Total Civil Servants	**2,178**
Civil Servant Skill Mix	
Scientific and Engineering	64%
Administration	30%
Technical	2%
Clerical	4%
On-site Contractor Employees	5,463
Off-/Near-site Contractor Employees	61
Total Contractor Employees	**5,524**
Total Construction Employees	**184**
Total Tenants	**1,125**
TOTAL KSC POPULATION	9,011

Procurement Report

Industry Partners at a Glance

The companies listed below were some of Kennedy Space Center's top support contractors or launch services contractors in terms of dollars obligated in FY2011. Following is a brief description of their work for the agency:

Boeing Space Operations

Boeing Space Operations was the prime contractor for the Checkout, Assembly and Payload Processing Services, or CAPPS, contract. Boeing's primary purpose was to support all aspects of payload processing for the International Space Station, space shuttle and expendable launch vehicles, or ELVs. As a partner in NASA's Commercial Crew Development 2 (CCDev2) initiative, Boeing supports NASA's goal to foster activity leading to the development of orbital Commercial Crew Transportation Systems. Under its CCDev2-funded Space Act Agreement, Boeing is continuing development of the CST-100 crew capsule, including maturation of the design and integration of the capsule with a launch vehicle.

URS Federal Technical Services, Inc.

URS Federal Technical Services provided base operations support for Kennedy. URS was responsible for operations, maintenance and engineering for specific Kennedy facilities, systems, equipment and utilities. URS Falso was responsible for calibration and propellants handling at the center.

Abacus Technology Corporation

Abacus provided communication and information technology services under the Information Management and Communications Support, or IMCS, contract. Abacus supported the majority of these requirements at Kennedy, which included support to agency programs, such as space shuttle, Constellation, payloads, launch services, and the International Space Station. Services provided include hardware and software integration development, computer administration and maintenance, voice and data transmission, library, graphics, publications, printing and reproduction, and IT security.

Analex Corporation

Analex was the prime contractor on the Expendable Launch Vehicle Integrated Services, or ELVIS, contract. Analex was responsible for performing and integrating the overall programmatic ELV business and administrative functions, including program and project planning, risk management, evaluation and information technology. Services provided include the management, operation, maintenance and sustaining engineering of NASA's ELV communications and telemetry stations located at CCAFS in Florida and VAFB in California. Analex also provided engineering services and studies, and technical services for various ground and flight ELV systems, missions and payloads.

QinetiQ North America – Mission Solutions Group

QinetiQ North America – Mission Solutions Group, or QNA, provided engineering products and services to Kennedy's Engineering and Technology Directorate and other center and agency operational customers. QNA provided laboratory and developmental shop maintenance and operations, technical services, spaceflight systems engineering and engineering development. QNA also provided technology outreach to foster awareness and utilization of Kennedy's unique capabilities.

United Launch Services LLC

United Launch Services, or ULS, a subsidiary of United Launch Alliance, brought The Boeing Co., Delta Launch Services Inc. and Lockheed Martin Commercial Launch Services together. ULS provided launch services to NASA using the Delta

II and Atlas V vehicles under two of three existing multiple-award, indefinite delivery, indefinite quantity task order contracts. Principal location for the Delta II vehicle assembly is Decatur, Ala. Principal location for the Atlas vehicle assembly is Denver, Colo. Both vehicles launch from CCAFS and VAFB.

Orbital Sciences Corp.

Orbital Sciences Corporation (OSC) of Dulles, Va., provided the agency's Launch Services Program with small- and medium-class expendable launch services at CCAFS, Vandenberg, Wallops Flight Facility in Virginia, and equatorial launch ranges. OSC provides launch services on both of the NASA Launch Services (NLS) I and II multiple-award indefinite delivery, indefinite quantity task order contracts.

Space Gateway Support, LLC

Space Gateway Support provided protective services at Kennedy under the Interim Protective Services Contract. Space Gateway Support was responsible for providing firefighting, physical security (including law enforcement), and emergency management response services to ensure the safety and security of day-to-day operations at Kennedy and to support launch activity.

Sierra Nevada Corporation

As a partner in NASA's CCDev2 initiative, Sierra Nevada Corporation supports NASA's goal to foster activity leading to the development of orbital Commercial Crew Transportation Systems. Under their CCDev2-funded Space Act Agreement, the company is maturing the design and development of the Dream Chaser Space System.

Space Exploration Technologies Corporation

Space Exploration Technologies Corporation or SpaceX, supports NASA's goal to foster activity leading to the development of orbital Commercial Crew Transportation Systems. Under its CCDev2-funded Space Act Agreement, SpaceX is developing an integrated launch abort system design for the Dragon spacecraft and evaluating crew accommodations.

Innovative Health Applications

Innovative Health Applications, or IHA, under the Medical and Environmental Support Contract, or MESC, provided a broad range of medical and environmental services to NASA. IHA operated the on-site Kennedy medical clinic, which conducts health exams, certifications and emergency medical treatment. IHA also performed occupational health services, aerospace medicine, industrial hygiene, environmental permitting, compliance and stewardship, ecological monitoring, and hazardous waste disposal. IHA operated Kennedy's fitness centers and provided education outreach to the center's employees.

Blue Origin, LLC

As a partner in NASA's CCDev2 initiative, Blue Origin supports NASA's goal to foster activity leading to the development of orbital Commercial Crew Transportation Systems. Under their CCDev2-funded Space Act Agreement, Blue Origin is accelerating development of their space vehicle, pusher escape system and reusable booster system.

Your Procurement Dollars at Work
Geographical Distribution by State
(Fiscal Year 2011 Obligations)

STATE	TOTAL DOLLARS
ALABAMA	1,575,989
ALASKA	5,093
ARIZONA	107,373
CALIFORNIA	88,298,472
COLORADO	430,613,970
CONNECTICUT	6,823,625
DELAWARE	4,934
DISTRICT OF COLUMBIA	837,674
FLORIDA	210,844,264
GEORGIA	509,060
ILLINOIS	1,017,529
INDIANA	111,982
KANSAS	7,674
KENTUCKY	93,923
LOUISIANA	10,208,288
MARYLAND	282,480,970
MASSACHUSETTS	1,193,576
MICHIGAN	689,812
MINNESOTA	844,067

STATE	TOTAL DOLLARS
MISSOURI	241,626
NEW HAMPSHIRE	445,464
NEW JERSEY	1,665,817
NEW MEXICO	614,722
NEW YORK	1,288,366
NORTH CAROLINA	2,672,501
OHIO	2,701,072
OREGON	119,262
PENNSYLVANIA	9,347,481
RHODE ISLAND	131,106
SOUTH CAROLINA	4,068
TENNESSEE	7,774,641
TEXAS	122,606,184
UTAH	136,960
VIRGINIA	245,818,243
WASHINGTON	22,132,087
WISCONSIN	39,435
WYOMING	7,090
TOTAL	**$1,454,014,400**

Top 25 KSC Business Contractors for FY 2011

Contractor	Dollars
UNITED LAUNCH SERVICES, LLC	344,586,113
QINETIQ NORTH AMERICA, INC.	152,674,810
URS FEDERAL TECHNICAL SERVICES, INC.	146,748,830
BOEING SPACE OPERATIONS COMPANY	177,747,033
ABACUS TECHNOLOGY CORPORATION	92,726,273
SIERRA NEVADA CORPORATION	84,500,000
SPACE EXPLORATION TECHNOLOGIES CORP.	75,328,375
SPACE GATEWAY SUPPORT, LLC	40,788,969
ANALEX CORPORATION	34,756,012
ORBITAL SCIENCES CORPORATION	27,909,662
INNOVATIVE HEALTH APPLICATIONS, LLC	24,078,078
BLUE ORIGIN, LLC	22,005,000
ASRC AEROSPACE CORPORATION	21,911,134
LOCKHEED MARTIN CORPORATION	16,106,487
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION	15,257,866
AIR LIQUIDE LARGE INDUSTRIES U.S. LP	11,144,769
MILLENNIUM ENGINEERING AND INTEGRATION CO	10,232,907
SPEEGLE CONSTRUCTION II, INC.	9,059,500
REDE-CRITIQUE	7,209,634
BREVARD ACHIEVEMENT CENTER, INC.	6,198,509
SWORD AND SHIELD ENTERPRISE SECURITY INCORPORATED	6,175,133
PRECISION FABRICATING & CLEANING COMPANY, INC.	5,034,569
REYNOLDS SMITH AND HILLS INCORPORATED	5,020,207
PRAXAIR INCORPORATED	4,654,989
IVEY'S CONSTRUCTION INCORPORATED	4,541,600
TOTAL	**$1,346,396,459**

National Aeronautics and Space Administration
John F. Kennedy Space Center
Kennedy Space Center, FL 32899

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NP-2011-10-207-KSC