

# THE KENNEDY SPACE CENTER



# 2005

# A N N U A L R E P O R T



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## CENTER DIRECTOR'S MESSAGE



The year 2005 will be forever remembered at KSC for continuing the rich history of human space flight with the return-to-flight launch of space shuttle Discovery during the STS-114 mission. This crowning achievement nearly 30 months after the tragic Columbia accident signaled a return to normalcy for the Space Shuttle Program.

At the same time, the work force supported the launches of five expendable launch vehicles that will both explore our universe and study our wonderful planet so we can learn more about the world around us. This was accomplished through the dedication of our diverse work force and its ability to embrace change while achieving the next chapter of greatness in our nation's storied space legacy.

During 2005, KSC also processed elements of the International Space Station, studied distant planets, and took the first steps to make America's new Vision for Space Exploration a reality for our nation.

Under the leadership of our NASA Administrator, Michael Griffin, our agency began implementing the vision set forth by President George W. Bush. The vision includes completing the International Space Station, developing NASA's next human space flight vehicle, returning astronauts to the moon, and continuing to explore Mars and beyond.

KSC's space accomplishments are not fulfilled for NASA alone, but for the global community. All people benefit from the advanced technology, science experiments, and products that eventually make their way from sterile labs, and sometimes space, to your businesses and homes.

By employing a combination of mission success, safety, teamwork and integrity as a beacon, we will continue our legacy of greatness.

## NASA VISION AND MISSION



The NASA Vision  
To improve life here,  
To extend life there,  
To find life beyond.

The NASA Mission  
To understand and protect our home planet,  
To explore the universe and search for life,  
To inspire the next generation of explorers  
...as only NASA can.

# events

## SIGNIFICANT EVENTS

### Main Engine Arrives

The third and final space shuttle main engine for Discovery's return-to-flight mission STS-114 arrives at Kennedy Space Center. The engine returned from NASA's Stennis Space Center in Mississippi where it underwent testing.



### Cupola Arrives

International Space Station element Cupola arrives at KSC. Shipped from Italy, the European Space Agency element is scheduled to be installed on the space station during the STS-133 mission. The dome-shaped module has seven windows to give astronauts a panoramic view.



### New "Shoes"

NASA's two crawler transporter vehicles receive new "shoes." The \$10 million project replaced both crawlers' 456 tread belt shoes, weighing more than one ton each. The shoes are critical for safely transporting the space shuttle to the launch pad.

10/07/04

10/08/04

10/12/04

10/13/04

10/15/04

11/20/04

### Normal Operations

The Vehicle Assembly Building resumes normal operations following repairs to lost panels caused by an active hurricane season. The building lost 820 panels from the south wall during Hurricane Frances, and Hurricane Jeanne pulled 25 additional panels off the east wall.

### White House Praise

During a National Disability Employment Awareness Month event, a White House administrator with the Office of Special Education and Rehabilitation Services praises KSC for the employment opportunities the center offers people with disabilities.



### Swift Launches

The Swift satellite launches aboard a Boeing Delta II launch vehicle from Cape Canaveral Air Force Station (CCAFS), Fla. The satellite will pinpoint the location of distant explosions that appear to signal the births of black holes.



# events

## SIGNIFICANT EVENTS



### Main Engines Installed

Space Shuttle Discovery's three main engines are installed. The engines, clustered at the tail of the orbiter, provide power to launch the shuttle into low-Earth orbit.

12/08/04

### John Young Retires

Space pioneer John Young retires after 42 years of service. Young is the only astronaut to fly on three human space flight programs (Gemini, Apollo and space shuttle). He participated in half a dozen space flights, including a moonwalk and the first space shuttle mission. He began his NASA career in 1962.

12/31/04



### Deep Impact Launches

Aboard a Boeing Delta II rocket, NASA's Deep Impact spacecraft launches to begin its 268-million-mile journey to Comet Tempel 1 to better understand a comet's interior. The comet has passed through the inner solar system several times and orbits the sun every 5.5 years, therefore making it a good target to study evolutionary change in the upper crust of a comet.

01/12/05

### O'Keefe Resigns

NASA's 10th administrator, Sean O'Keefe, resigns after three years with the agency.

12/13/04



### Redesigned Tank

The redesigned external tank rolls out from the barge that carried it to KSC from NASA's Michoud Assembly Facility in New Orleans, and is examined at the Vehicle Assembly Building. It is eventually attached to the twin solid rocket boosters and Space Shuttle Discovery for the return-to-flight mission, STS-114.

01/06/05



### Columbia Anniversary

Hundreds of people gather at the KSC Visitor Complex Space Mirror Memorial to honor the fallen astronauts of space shuttle Columbia on the second anniversary of the tragedy.

02/01/05



# events

## SIGNIFICANT EVENTS

### Second Tank at KSC

NASA's second redesigned space shuttle external tank, designated for use on Atlantis' return-to-flight mission STS-121, is now at KSC.

03/15/05

### DART Launch

NASA's Demonstration of Autonomous Rendezvous Technology (DART) space vehicle launches aboard a Pegasus XL expendable launch vehicle from Vandenberg Air Force Base, Calif. DART was designed to demonstrate technologies to allow a space vehicle to locate and dock with another spacecraft without direct human guidance.

04/15/05



### New Control Tower

Rising 110 feet above the Shuttle Landing Facility (SLF) runway midpoint, the new NASA control tower and Media Operations Facility are formally unveiled. The tower manages all SLF landings and departures within KSC and CCAFS restricted airspace.

07/08/05

04/14/05

### New Administrator

NASA's new administrator, Michael D. Griffin, reports to work as the agency's 11th leader.



05/20/05

### NOAA-N Launch

The National Oceanic and Atmospheric Administration's NOAA-N launches on May 20, 2005, aboard a Delta II from VAFB. The satellite makes global measurements of Earth's atmospheric temperature, humidity, surface temperature, cloud cover and other weather features for inputs to atmospheric and surface forecast models.



07/26/05

### Discovery Lifts Off

NASA's space shuttle return-to-flight mission (STS-114) is under way. Space Shuttle Discovery lifts off from KSC at 10:39 a.m. EDT to make its way to the International Space Station.





# events

## SIGNIFICANT EVENTS

### Discovery Lands

Completing a 14-day, 5.8-million-mile journey in space, Space Shuttle Discovery lands at Edwards Air Force Base in California. Landing at KSC wasn't feasible due to thunderstorms. The mission included an unprecedented orbiter back flip maneuver, equipment and procedure tests, a first-of-its-kind spacewalking repair, and phone conversations between the astronauts and President George W. Bush and Japanese Prime Minister Junichiro Koizumi.



### Discovery Returns to KSC

Space Shuttle Discovery returns to KSC from California atop a modified Boeing 747 called the Shuttle Carrier Aircraft.

### Recovery Efforts

KSC employees head to Stennis and Michoud with much-needed emergency equipment, food and medical supplies to assist with the recovery efforts associated with Hurricane Katrina.

08/09/05

08/12/05

08/21/05

08/29/05

09/02/05



### Flight to Mars

A seven-month flight to Mars begins as NASA's Mars Reconnaissance Orbiter launches aboard an Atlas V launch vehicle from CCAFS. This was the first Atlas V launch of an interplanetary mission.



### Hurricane Katrina

The Category 4 Hurricane Katrina moves ashore near the Louisiana-Mississippi border and affects Stennis Space Center, Miss., and Michoud Assembly Facility in New Orleans. Stennis provides shelter to 4,000 employees and their families during the storm. Some Stennis buildings sustain water and roof damage. At Michoud, which makes the external fuel tanks for NASA's space shuttles, several buildings suffer window and roof damage. Space flight hardware is not damaged. Hundreds of employees are left homeless by the hurricane.

## NASA'S CORE VALUES

NASA employees recognize their responsibilities and are accountable for the important work entrusted to them. Our shared core values express the ethics that guide our behavior, and form the basis for our decisions.

### **Mission Success**

On behalf of the nation, NASA is privileged to take on missions of extraordinary risk and complexity to explore, discover and learn. We believe that mission success is the natural consequence of an uncompromising commitment to safety, teamwork and integrity.

### **Safety**

NASA's constant attention to safety is the cornerstone upon which we build mission success. We are committed, individually and as a team, to protecting the safety and health of the public, our team members, and those assets that the nation entrusts to us.

### **Teamwork**

NASA's most powerful tool for achieving mission success is a multi-disciplinary team of competent people. The agency will build high-performing teams that are committed to continuous learning, trust, and openness to innovation and new ideas.

### **Integrity**

NASA is committed to an environment of trust, built upon honesty, ethical behavior, respect and candor. Building trust through ethical conduct as individuals and as an organization is a necessary component of mission success.



Former Kennedy Space Center Deputy Director Woodrow Whitlow Jr. presents an award for a winning entry in the NASA Values essay contest to Mary Erdmann with Bionetics during the One NASA Leader-Led Workshop. Erdmann was one of four KSC workers recognized for essays on NASA's four core values.

> The open doors of the Vehicle Assembly Building shed a light border around the external tank on Space Shuttle Discovery as the stacked vehicle begins its trek to Launch Pad 39B for return-to-flight mission STS-114.







## SPACE SHUTTLE PROCESSING

Kennedy Space Center's space shuttle processing team concentrated on completing the Columbia Accident Investigation Board (CAIB) recommendations and preparing orbiter Discovery for NASA's much-awaited, return-to-flight mission. Major activities included a total refurbishment of Discovery and Launch Pad 39A and B, redesign of the external tank's foam and application, and certification of Launch Control Center firing room 4.

### **STS-114 Return-to-Flight Launch and Landing**

The success of return-to-flight mission STS-114 began with Discovery's launch on July 26, 2005, from Launch Complex 39B. The launch followed more than two and a half years of extensive vehicle and facility modifications and processing enhancements in response to the CAIB recommendations. The STS-114 integrated flow, while quite successful, was not without its challenges. The NASA/contractor team executed several non-stan-

installed behind the reinforced carbon-carbon (RCC) panels as part of Discovery's wing leading edge sensor modification to detect potential damage during launch and ascent. The Canadian-built Orbiter Boom Subsystem was installed in the payload bay area to provide the astronauts with the capability to inspect the underside of the orbiter for tile and RCC damage with newly installed cameras. Wiring was installed on Discovery for the new external tank separation cameras.

The historic 14-day mission of STS-114 concluded on Aug. 9, 2005, with a successful landing at Edwards Air Force Base in California. Orbiter Discovery returned to KSC atop the Shuttle Carrier Aircraft on Aug. 21, 2005.

### **First Orbiter Major Modification Completed at KSC**

Discovery underwent a full orbiter major modification in KSC's Orbiter Processing Facility prior to its return to flight. Workers logged a total of ap-



Against the backdrop of a golden sunset, Space Shuttle Discovery, sitting atop the mobile launcher platform, on the crawler transporter, traverses the crawlerway toward Launch Pad 39B for its return-to-flight mission STS-114.

dard procedures, including two external tank tanking tests, rollback from the pad, an orbiter de-mate and swapping of the external tank and solid rocket boosters for another set.

The processing team completed 19 return-to-flight modifications on Discovery. Twenty-two temperature sensors and 66 accelerometers were

proximately 3.5 million hours to prepare Discovery for launch, replacing more than 25,000 parts. Nearly every major orbiter component was removed, inspected and reinstalled, including all windows, the orbital maneuvering system pods, forward reaction control system, rudder speed brake and all of its actuators, body flap, and all wing leading edge reinforced carbon-carbon panels. Discovery underwent approximately 286 modifications during its STS-114 processing flow. Some of the major modifications installed in the orbiter included the



In the Orbiter Processing Facility, Matt Scott (left) with United Space Alliance and Donald Wall with NASA Quality Assurance closely inspect the final reinforced carbon-carbon panel to be installed on orbiter Discovery's left wing in preparation for mission STS-114.

# Shuttle

multi-functional electronic display system, or “glass cockpit,” multi-purpose logistics module cooling enhancements, wireless video, thicker window panes and increased payload capabilities.

## External Tank Tanking Tests

Using a high degree of technical and operational competence, the workers conducted two external tank tanking tests during the STS-114 integrated flow. The processing team also responded exceptionally to demands for the second tanking test, even with limited time to accomplish the ground and flight system turnaround, define and implement troubleshooting requirements, and execute the test. The team corrected abnormal conditions associated with the external tank engine cutoff sensors and the hydrogen prepress system prior to the first actual launch attempt.

## External Tank Cameras

Several new cameras were attached between the external tank and orbiter as part of the new Enhanced Launch Vehicle Imaging System (ELVIS) to provide improved real-time video images of the tank during STS-114's launch. The camera system is part of the first-generation ELVIS project. During and after launch, the video was downlinked in real time and analyzed.

## External Tank Bipod Fitting

The bipod fitting was redesigned to eliminate the use of a foam ramp. The redesign required additional heating to keep ice and frost from forming on the tank and becoming debris. Also, tempera-

ture monitoring, variable power and active temperature controls were added as requirements for the new bipod fitting heater system.

## Firing Room 4 Acceptance

Inside the Launch Control Center, the newly modernized Launch Processing System in Firing Room 4 reached operational readiness on Aug. 19,



Johnson Controls operator Kenny Allen works on the recently acquired Contraves-Goerz Kineto Tracking Mount with a two-camera control unit that will be used during launches. The KTM is remotely controlled and offers film and shuttered and high-speed digital video.





2005, after two years of refurbishment. The firing room was used during processing of Discovery inside the Orbiter Processing Facility in late August 2005 and will be used for the first time for shuttle processing flow and launch during mission STS-121 in 2006. Upgrades included new console enclosures, remote air-handlers, sound-absorbing wall and floor material, enhanced humidity control, anti-static flooring, an automatic and non-halon fire suppression system and a modern power distribution system that will enhance operations and increase equipment space.

### New Transoceanic Abort Landing Site

The Space Shuttle Program selected the French Air Force Base in Istres, France, as a replacement for the Ben Guerir, Morocco Transoceanic Abort Landing (TAL) site. This reduces the probability of a launch scrub caused by poor weather at existing TAL locations.

Istres Air Base is used by the French Air Force for pilot training and as a flight test center, where fighter aircraft are tested and improved. The KSC team, working with the French Air Force, three other agency centers, NASA Headquarters, the American Embassy in Paris and the U. S. Air Force, coordinated the installation of equipment at the base, including underground utilities, concrete foundations, and visual and electronic landing aids.

Pre-existing runway lighting wasn't sufficient, so KSC and the French Air Force developed an engineering solution to install special Xenon lighting near the runway threshold for night landings and near the touchdown end. A new electronic navigation aid provides range and bearing to the orbiter during landing. A microwave scanning beam landing system was installed at the runway to provide precision guidance from 15 miles to touchdown.

The KSC team established an operation building near the base, providing warehouse space for

Above: In the Orbiter Processing Facility, during the Crew Equipment Interface Test activities, members of the STS-114 crew get a hands-on look at tools from the Tool Stowage Assembly. At left is Mission Specialist Stephen Robinson and at right is Mission Specialist Soichi Noguchi, who is with the Japanese Space Agency.

Below: In the Orbiter Processing Facility, United Space Alliance Technician Lisa Campbell handles components of the new Wing Leading Edge Impact Detection System being placed on the wing leading edge of orbiter Discovery.





Aft mechanical technicians attach dome heat shields to the space shuttle main engines on orbiter Atlantis in the Orbiter Processing Facility. The shields provide protection for the orbiter against the high temperatures generated by the engines.

equipment and operations offices, and installed a 50-foot-tall communications tower and weather instrumentation at the site necessary for KSC operations in case of an emergency landing. Istres was activated as a certified TAL site and successfully supported the STS-114 launch.

### Launch Pad Refurbishment

Launch Complex 39B was designated the return-to-flight launch pad for mission STS-114. Refurbishment of the launch pad structure included correcting critical debris issues. All of the old zinc coating was removed from the Fixed Service Structure and the Rotating Service Structure using abrasive blasting with a coal slag grit. The structures were then recoated with a coating system composed of a layer of zinc paint and an inorganic topcoat. Work directly associated with the Columbia Accident Investigation Board recommendations included coating the wing covers of the Rotating Service Structure with a layer of epoxy and a coating of polyurethane sealant to significantly reduce porosity and prevent future oxidation and debris. The project was performed by local contractor Ivey's Construction of Merritt Island.

Other significant work included the redesign of bearing materials on the hinge column between the Fixed Service Structure and the Rotating Service Structure on each launch pad to correct the design overload. Redesign of the duct tips on the gaseous oxygen vent arm provided a more efficient method of supplying heated gaseous nitrogen. Launch tower modifications included enlarging the opening that the gaseous hydrogen vent arm line enters by about 9 inches to prevent the vent line/carrier plate assembly from contacting the tower structure during launch.

### KSC Return-to-Flight Design Certification

Major activities performed at KSC to return our shuttles and astronauts to space included reviewing and certifying modifications on critical systems and facilities. Hardware, software and processing issues were improved upon, and CAIB recommendations applicable to KSC were implemented.

KSC performed 105 return-to-flight modifications to ground-support equipment or facilities. About 500 software changes to the launch processing system were performed to provide significant enhancements for engineering and shuttle processing activities. All of this work began in the summer of 2004 and was completed in May 2005.

In the back transfer aisle of the Orbiter Processing Facility, NASA Quality Assurance Inspector Matt English checks paperwork for the thermal protection system blanket to be wrapped around the orbiter boom sensor system in the payload bay of orbiter Discovery for return-to-flight mission STS-114.





## INTERNATIONAL SPACE STATION AND PAYLOAD PROCESSING

Workers inside the Space Station Processing Facility maintained approximately 250,000 pounds of hardware scheduled to be delivered to the International Space Station. This includes six truss elements for delivery to the station on flights scheduled for 2006 and 2007. Two multi-purpose logistics modules and a Spacehab module are also maintained on a constant basis. These will be used to ferry supplies, experiments and other smaller items to the station, and bring waste materials, completed experiments or hardware in need of repair back to Earth. The Japanese Experiment Module and the Alpha Magnetic Spectrometer also are in the processing facility.

To support these future missions, representatives from the Japanese Aerospace Exploration Administration, European Space Agency and Russian Space Agency have been a constant presence at KSC. Directorate personnel interface with these representatives on a regular basis to plan testing, payload processing and the eventual launch and delivery of the international partner's components to the station.

### **Fiber Optic Pin Inspection Tool Development**

KSC engineers developed different methods to safely inspect fiber optic pins on space flight equip-

ment. New and safer methods were developed through the efforts of NASA and Boeing engineers, contractors and private vendors. The new tools reduce the risk of damage because they never touch the pins. They enhance productivity and efficiency for aerospace workers dealing with fiber optic pin connectors. The processing of space flight equipment is proceeding with improved safety and efficiency.

### **STS-114/LF-1 (Raffaello)**

The Italian-built, multi-purpose logistics module Raffaello, which was processed at KSC, delivered food, clothing, spare parts and research equipment to the International Space Station. Included with 12 large containers was the Human Research Facility-2. This module will expand the station's capability to support human life sciences research. The External Stowage Platform-2 was also delivered and attached to the station's airlock and will serve as a permanent storage facility for spare parts.

### **STS-121/ULF-1**

The space station processing team prepared several payloads for mission STS-121. A new Trailing Umbilical System (TUS), which will replace one that failed on orbit, was processed and tested in preparation for delivery to the station. The TUS

In the Space Station Processing Facility, technicians attach the Cargo Element Lifting Assembly down rods to the External Stowage Platform in preparation for lifting the ESP-2 from its transportation container and installing it into the Payload Transportation Canister for transfer to Discovery's payload bay at Launch Pad 39B.





In the Space Station Processing Facility, a worker stands by as the Rack Insertion Device slowly moves the Human Research Facility-2 science rack into the multi-purpose logistics module Raffaello for flight on Discovery's return-to-flight mission STS-114.

the space station in late 2009. The module will give astronauts a panoramic view for observing many operations on the outside of the orbiting complex, enhance the astronaut arm operator's situational awareness, and supplement television camera views and graphics. It will provide external observation capabilities during spacewalks, docking operations, hardware surveys and Earth and celestial studies. The Cupola is the final element of the space station's core.

#### **NODE-2**

The NODE-2, manufactured by Alenia Spazio in Italy for the European Space Agency, is the second of three station connecting modules. When delivered to the station, it will be attached to the end of the U.S. lab and provide attach locations for the Japanese laboratory, European laboratory, the Centrifuge Accommodation Module, and a docking point for multi-purpose logistics modules.

During the past year, significant NODE 2 processing activities were accomplished inside the Space Station Processing Facility, including verification and validation of the module for flight. The Node 2 is scheduled for launch on a mission to the space station in late summer 2007.

is part of the mobile transporter system attached to the station. The umbilical system controls the movement and direction of the mobile transporter as it navigates along the station's external truss system. The TUS is essential for the installation of additional truss elements.

Also, a new Oxygen Generation System was processed and prepared for mission STS-121. It will be delivered to the station to support the generation of oxygen that is a vital commodity on orbit.

#### **STS-123/1-E (Columbus Module)**

International Space Station/Payloads supported the design reviews of the Columbus module in preparation for delivery to KSC. The Columbus module is scheduled to be installed on the station during mission STS-123. Workers in Bremen, Germany, continue to complete the work necessary for transfer and shipment to KSC. Columbus is designed as a general-purpose laboratory to support European Space Agency materials and fluid sciences, life sciences and technology development.

#### **European Space Agency Cupola Module**

The Cupola, a dome-shaped module with seven windows, was uncrated inside the Space Station Processing Facility. The module was shipped from Alenia Spazio in Turin, Italy, for the European Space Agency. The Cupola is scheduled to be installed on

In the Space Station Processing Facility, workers help guide the Control Moment Gyroscope as a crane lowers it onto the Small Adapter Plate Assembly. The CMG was delivered to the International Space Station on mission STS-114 to replace one that had failed.





## LAUNCH SERVICES PROGRAM

NASA's Launch Services Program was busy with five successful launches of expendable launch vehicles, including the first NASA mission to launch aboard an Atlas V, and other projects supporting the Vision for Space Exploration. A skilled team worked to provide safe, reliable, cost-effective and on-schedule processing, mission analysis, spacecraft integration and launch services for NASA and agency-sponsored payloads on expendable launch vehicle missions.

While overseeing the missions of the fiscal year, the Launch Services Program team also managed more than 30 future missions and worked with other NASA centers, including the Jet Propulsion Laboratory in Pasadena, Calif., Marshall Space Flight Center in Huntsville, Ala., Goddard Space Flight Center in Greenbelt, Md., and the Applied Physics Laboratory at Johns Hopkins University in Laurel, Md., to plan and process NASA's scientific, research and communications spacecraft for launch.

In November 2004, NASA entered a partnership with the Defense Advanced Research Projects Agency (DARPA), a part of the U.S. Department of Defense, in support of the DARPA-sponsored FALCON Program. A key objective of the FALCON Program is to demonstrate affordable and responsive space lift capability. The Launch Services Program was assigned the responsibility to manage and coordinate NASA's contributions to the partnership, including funding, expertise and use of launch site capabilities at the Wallops Flight Facility in Virginia and participation from KSC, Marshall and Wallops.

Erupting from the flames and smoke beneath it, NASA's Deep Impact spacecraft lifts off from Launch Pad 17-B, at Cape Canaveral Air Force Station, Fla., on Jan. 12, 2005. Deep Impact was heading for space and a rendezvous 83 million miles from Earth with Comet Tempel 1 on a mission to reveal the secrets of the comet's interior.

### Atlas V Launch Vehicle Certification

The Launch Services Program is responsible for certifying any launch vehicle used by NASA to ensure that government-owned spacecraft assets are not exposed to undue risk. The program's engineering and analysis teams undertook a huge effort to perform a complete flight margin verification of three consecutive flights while completing other important duties such as assessing vehicle reliability and hardware and software qualifications. Vehicle certification included the Atlas V 401 supporting the Mars Reconnaissance Orbiter mission and the Atlas V 551 for the New Horizons spacecraft, which launched on Jan. 19, 2006, from CCAFS.



## FISCAL YEAR LAUNCHES

**Swift**, a NASA mission with international participation, launched Nov. 20, 2004, aboard a Delta II from Cape Canaveral Air Force Station. Swift is a satellite dedicated to addressing the gamma-ray burst mystery.

**Deep Impact** is humanity's first space mission to literally take an "in-depth" look inside a comet. The satellite launched on Jan. 12, 2005, from CCAFS aboard a Delta II. This NASA Discovery Mission probed the mysteries of these heavenly nomads by flying a specially designed impactor into comet Tempel 1 on July 4, 2005. The resulting cosmic fireworks exposed fresh materials from the comet's interior, allowing the close Deep Impact "flyby" spacecraft to document the consistency and chemistry of materials beneath the exterior. Results from this seven-month mission will lead to a better understanding of comets, some of the solar system's most flamboyant constituents.

**The Demonstration of Autonomous Rendezvous Technology (DART)** space vehicle launched, April 15, 2005, aboard a Pegasus XL from Vandenberg Air Force Base, Calif. While NASA has performed rendezvous and docking missions in the past, astronauts have always piloted the vehicle. DART was designed to demonstrate technologies to allow a space vehicle to locate and dock with another spacecraft without direct human guidance. The DART space vehicle performed a series of navigational maneuvers using a global positioning system and an advanced video guidance sensor to approach a target satellite.

**NOAA-N** is included in the National Oceanic and Atmospheric Administration's ongoing series of polar-orbiting weather satellites. The satellites make global measurements of atmospheric temperature, humidity, surface temperature, cloud cover, water-ice-moisture boundaries, and space proton and electron fluxes for inputs to atmospheric and surface forecast models. NOAA-N launched May 20, 2005, aboard a Delta II from Vandenberg.

**The Mars Reconnaissance Orbiter (MRO)** spacecraft launched Aug. 12, 2005, from CCAFS aboard an Atlas V launch vehicle. The MRO



Above: NASA's encapsulated Mars Reconnaissance Orbiter nears the top of the Vertical Integration Facility on Launch Complex 41 at Cape Canaveral Air Force Station, Fla. The spacecraft was mated with the Atlas V rocket already in the tower. MRO is the next major step in Mars exploration.



In Hangar AE at Cape Canaveral Air Force Station, Fla., technicians with Spectrum Astro Inc. prepare to cover the Swift spacecraft with plastic before moving it to the launch pad.



was the first NASA mission to use the Atlas V launch vehicle. The spacecraft will characterize the surface, subsurface and atmosphere of Mars, and will identify potential landing sites for future missions. After a seven-month cruise to Mars and six months of aerobraking to reach its science orbit, the MRO will provide information about the history of water on Mars. Its science instruments will zoom in for extreme close-up photography of the Martian surface, analyze minerals, look for subsurface water, trace how much dust and water are distributed in the atmosphere, and monitor daily global weather. These studies will help determine if there are deposits of minerals that form in water over long periods of time, detect any shorelines of ancient seas and lakes, and analyze deposits placed in layers over time by flowing water.



At the upper level of the launch service tower on Launch Complex 37 at Cape Canaveral Air Force Station, Fla., the Geostationary Operational Environmental Satellites (GOES-N) spacecraft is lowered toward the Boeing Delta IV second stage. GOES-N is the latest in a series of Earth-monitoring satellites and is scheduled to launch no earlier than May 18, 2006.

**SpaceTech 5 (ST5)** launched on March 22, 2006, from Vandenberg, aboard a Pegasus XL vehicle. This New Millennium Program mission comprises three miniature spacecraft called “micro-sats.” ST5 will flight-validate innovative technology concepts in order to reduce risks on future science missions. ST5’s miniaturized components include a cold gas micro-thruster, X-band transponder communication system, variable emittance coatings for thermal control, and a low-voltage power system. ST5 will demonstrate the ability of small spacecraft to perform research-quality science by measuring the Earth’s magnetic field using highly sensitive magnetometers. This type of measurement will be useful for future missions that will study the effect of solar activity on the Earth’s magnetosphere, the region of upper atmosphere that surrounds our planet, to help us understand the “space weather” that can disrupt our communication, navigation and power systems.

## FUTURE MISSIONS

**The CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) and CloudSat** satellites are scheduled to launch aboard a Delta II launch vehicle in April, from Vandenberg Air Force Base, Calif.

The satellites were developed to provide scientists a new, 3-D perspective on Earth’s clouds and airborne particles called aerosols.

Their mission is to evaluate and help answer questions about how clouds and aerosols form, evolve and affect water supply, climate, weather and air quality. The satellites will contribute to better weather prediction, mitigation of natural hazards, water resource management and understanding of climatic processes.

**Solar Terrestrial Relations Observatory (STEREO)** is being built by the Johns Hopkins University’s Applied Physics Laboratory in Maryland under contract to Goddard. It is scheduled to launch in the summer aboard a Delta II from CCAFS. STEREO has a two-year mission employing two nearly identical observatories that will provide 3-D measurements of the sun to study the nature of coronal mass ejections. These powerful eruptions are a major source of the magnetic disruptions on Earth and a key component of space weather, which can greatly affect satellite operations, communications, power systems, the lives of humans in space, and global climate.





## EXPLORATION

Kennedy Space Center employees made important contributions to support the nation's Vision for Space Exploration.

### **Exploration Operations Integration Office**

The Exploration Operations Integration Office at KSC led the center's support of NASA's Constellation Systems, which is responsible for developing the vehicles and infrastructure that will allow us to return to the moon, then travel to Mars and beyond.

Constellation Systems will develop the crew exploration vehicle and other exploration-related elements, including the crew launch vehicle, cargo launch vehicle and lunar surface access module. The office supported the NASA Administrator's Exploration Systems Architecture Study (ESAS) to develop the best strategy to minimize the gap between an operational crew exploration vehicle and retirement of the shuttle in 2010.

The KSC ESAS team helped define Constellation operations requirements and provided technical leadership in the areas of ground processing, test and verification, logistics, launch, landing, recovery, safety and mission assurance.

In addition to the architecture study, KSC personnel helped lead or support the crew exploration vehicle acquisition effort, multidiscipline concept and requirements development, and numerous other ground operations-oriented studies for Constellation Systems.

Like the Apollo and space shuttle vehicles, the crew exploration vehicle will represent the next generation in human space flight. The ability to travel and explore the solar system will rely on KSC's experience in ground processing, systems engineering, integrated test and verification, logistics, systems integration, launch, landing and recovery, facility and ground systems design and development, and human factors.

### **Applied Technology Development Efforts**

The KSC Exploration Project office worked with project teams from other NASA centers, government agencies, industry and academia to perform important development work pertinent to



attaining goals in the Vision for Space Exploration. KSC led a project for developing a capability that will, for the first time, enable future system operations analysts to understand, estimate and make informed decisions about the supply chain for future space transportation systems. These improvements will significantly advance life-cycle cost estimating and analysis and increase our understanding of sustainability, affordability, reliability and safety, which are inseparable from supply chain operations. KSC also led a project addressing the usefulness of three distinct, but closely related concepts: electrostatic radiation shielding, ion beam propulsion, and beamed energy delivery to future space exploration architectures.

KSC employees participated on many other projects. An example was the determination of magnetic properties of lunar dust and the evaluation of methods for dust collection, removal and transport. KSC participated in several projects concerning in-situ resource utilization. These include developing methods for identifying natural resources on the moon and on planetary bodies, as



# exploration

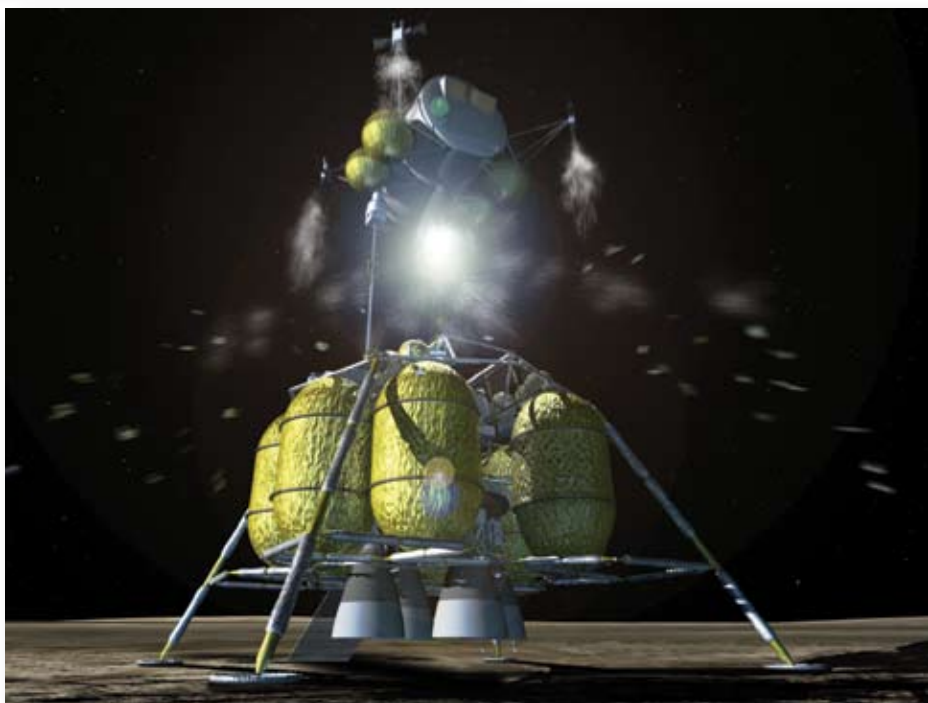


An artist's rendering of NASA's crew exploration vehicle (top) and lunar vehicle (bottom).

well as using these resources for construction of outposts and generation of propellants.

Other in-situ resource utilization projects included beginning to develop a modular characterization instrument suite, creating an oxygen production system design, and developing a process for generating oxygen as a by-product of metal and metallic alloy production.

Additional work included a project for integrating geospatial data in a series of products to assist in navigation for use with the crew exploration vehicle, and with spacecraft and facilities planning. KSC's exploration office was also involved in a project to develop new wiring materials with self-healing properties and polymeric materials with increased conductivity, and developing bioregenerative technologies for water systems and integrated biological surface systems.



## APPLIED TECHNOLOGY

The center's cutting-edge technology advancements improved operations close to home and circled the globe.

KSC's research and technology experts supported space shuttle return-to-flight efforts. The Electromagnetic Physics Lab developed a sensor and performed testing to measure electrostatic charge buildup on shuttle orbiter insulation. There was a concern that charge buildup could cause sparks if the insulation blankets were not properly configured. The testing identified several blanket configurations that required modification to prevent this.

The Applied Physics Lab developed a bank of infrared projectors, which would serve as a backup solution to other measures to reduce ice buildup on the shuttle's external tank during countdown.

The Cryogenics Test Lab developed a method for preventing ice buildup on the exposed fuel pipe of the external tank bellows. The design was wind-tunnel tested to meet stringent launch requirements. It was ready in case heaters could not be certified and installed in time for launch.

Technologies were developed to increase safety and productivity. With time and use, the orbiter's reaction control system nozzles can degrade, and the number of spare nozzles is dwindling. To aid in inspections and prepare the space shuttle for



In the Cryogenics Test Lab, a technician performs an insulation thermal performance test using liquid nitrogen. Several patents for this process were granted in 2005.

launch, workers developed the reaction control system coating, acoustic hole and fuel hole inspection tools.

The space shuttle's thermal protection system tiles are susceptible to water saturation, which can make the vehicle heavier. Previously, heat lamps baked the water out. In replacement, the Applied Physics Lab delivered a new vacuum system that removes more water and does so in less time. The system was put to the test when the orbiter was caught in a rainstorm after landing at Edwards Air Force Base in California after the STS-114 mission.

The Space-based Telemetry And Range Safety (STARS) system supported the historic Virgin Atlantic GlobalFlyer flight by providing real-time video, audio and still images of pilot Steve Fossett. The three-day, solo, non-stop flight around the world began Feb. 28 from Salina, Kansas. STARS, which demonstrates the capability of a space-based platform to provide communication and tracking support for various launch vehicles, was modified to remove excess size and weight on the aircraft. The system successfully transmitted video to Mission Control at Kansas State University in Salina. The hardware and software exceeded performance expectations, and STARS development continues through test flights.

In the Applied Physics Lab, NASA physicist Doug Willard demonstrates the tool developed to detect water in the space shuttle's thermal protection system tiles.

















Page 23: STS-114 Commander Eileen Collins leads the way as the crew walks from the Operations and Checkout Building en route to Launch Pad 39B. In the left row, from front, are Pilot James Kelly and Mission Specialists Wendy Lawrence, Charles Camarda and Andrew Thomas. In the right row, from front, are Collins and Mission Specialists Soichi Noguchi and Stephen Robinson.

Center Spread: Clouds of smoke and steam roll away from Launch Pad 39B as Space Shuttle Discovery roars into the sky on July 26, 2005, on return-to-flight mission STS-114.



In the early morning hours of Aug. 22, 2005, at Kennedy Space Center's Shuttle Landing Facility, the orbiter Discovery is slowly lowered toward the ground from the mate/demate device. Discovery landed at Edwards Air Force Base in California on Aug. 9 after 13 days in space on mission STS-114. Visible on the orbiter is the tail cone that covers the main engines during the ferry flight from California.

With the establishment of a Government and Community Relations Division, KSC continues to build on its history of partnerships with space-related industry leaders, customers, and community and legislative officials to accomplish agency and center goals.

KSC continues to expand its partnership with the state of Florida. Through formal and informal partnerships with several branches of Florida's government, KSC and Florida's Office of Trade, Tourism and Economic Development met several goals and objectives. For example, by partnering with KSC, Enterprise Florida Inc. (in association with regional economic developers) prepared a state incentive plan to potentially attract additional crew exploration vehicle assembly work to Florida.

The creation of the Commission on the Future of Space and Aeronautics in Florida was a major milestone that could foster new opportunities for KSC to partner with Florida in greater capacities. This commission examined Florida's existing space programs to make recommendations for maximizing the state's leadership as the "gateway to space."

The partnership with the state also launched joint education projects with the Florida Space Research Institute and several financial projects with the Florida Aerospace Finance Corp. Other state partners included Florida Aviation Aerospace Alliance, Florida universities and institutes, the Center for Aerospace Technical Education, Metro Orlando Economic Development Commission, and key Chambers of Commerce and their associated civic organizations.

KSC's partnerships with charitable organizations in Brevard County, principally United Way of Brevard, served as a vehicle for employees to contribute to our healthy and growing local community, as well as numerous charities across the nation. In keeping with this year's theme, "Launching Dreams of Those in Need," KSC employees voluntarily contributed a record-breaking \$433,000 in donations through the 2005 Combined Federal Campaign, with more than \$158,000 going to lo-

cal charities and nearly \$20,000 designated for the NASA Family Assistance Fund.

As always, the U.S. Air Force 45th Space Wing continues to be a key KSC partner and plays a vital role in supporting the center's space shuttle launches and numerous expendable launch vehicle missions. Through the Cape Canaveral Spaceport Management Office, the wing and the center managed joint base operations at KSC and the Cape Canaveral Air Force Station. This partnership resolved key return-to-flight recommendations and embraced the Vision for Space Exploration.

KSC's government relations liaisons and senior management supported extensive activities to maintain and enhance KSC's legislative relationships with local, state and federal elected officials. KSC representatives briefed members of the Brevard County Commission, Florida Legislature, Florida Governor's Office and Florida Congressional Delegation, focusing on the Vision for Space Exploration and other initiatives involving the center. KSC also participated in events marking the annual Florida Space Day in Tallahassee.

Throughout the year, the center hosted legislative staff including local elected officials, state representatives and senators, White House staff and members of the first family to learn about KSC and view critical milestones such as the STS-114 launch.



Lynda Weatherman (left), president and CEO of the Economic Development Commission of Florida's Space Coast, and Center Director Jim Kennedy shake hands after signing a three-year Space Act Agreement for economic development cooperation in support of existing and future missions of NASA at KSC.



> Sunlight glistens on the feathery crown of a snowy egret in the marshes at Kennedy Space Center.

## ENVIRONMENTAL LEADERSHIP

The center's work force recognizes the significance of being situated on a wildlife refuge. Therefore, KSC's Environmental Program applies both proven and new techniques to conserve and protect local and global resources.

KSC is addressing the energy concerns facing our nation today. Corn and other grain products are now providing ethanol fuel for several hundred vehicles at KSC. The renewable fuel provides a constant resource that doesn't deplete oil supplies, is biodegradable and reduces greenhouse gas emissions. The fuel, known as E85, is 85 percent ethanol and 15 percent gasoline. Selling for nearly the same price as unleaded gasoline, ethanol is domestically produced, making U.S.-grown feed grains more valuable.

Additional ethanol resources, such as agricultural and forestry wastes, are under investigation. After ethanol is produced, the remaining protein, minerals, vitamins and fibers are sold as livestock feed. The carbon dioxide that escapes during processing is captured by crops for nutrients. In the case of a spill, ethanol also poses less environmental risk than oil

or gasoline, as ethanol degrades quickly in water.

To identify and manage the environmental impact of facility operations, all federal facilities are required by executive order to have an Environmental Management System (EMS) in place by the end of 2005. Nine months before the deadline, KSC formed an EMS Core Team representing all major NASA and contractor organizations. The team, which is assessed annually, and KSC's Environmental Program analyzed potential environmental impacts and developed a plan to minimize potential adverse impacts to the environment.

KSC's Environmental Remediation Program is cleaning up unintentional contamination of soil and groundwater resources caused by five decades of operations and processing associated with groundbreaking rocket launches. The contamination occurred before the potential for damage was recognized. Nearly 35,881 tons of contaminated soil were removed from the center in 2005.

For further details about KSC's Environmental and Energy Programs, visit <http://environmental.ksc.nasa.gov/>.



David Ishiyama, a student, participates in KSC's Spaceflight and Lunar Sciences and Technology Program by collecting soil samples near Launch Complex 39.





## EDUCATION

Equipped with the center's unique facilities and more than 200 years of combined teaching experience, Kennedy's Education Programs and University Research Division prepares students to pursue careers related to exploration, and educates the public in NASA's activities and discoveries.

The NASA Explorer Schools (NES) program, which focuses on fourth-through ninth-grade educators and students, added five new teams from Florida and Puerto Rico to KSC's 10 existing teams. KSC provided professional development for NES teachers, and NES schools enjoyed a remarkable year. One school's experiment flew on a NASA aircraft, another's relativity experiment will fly on a future space shuttle mission, and another received a supplemental \$1.6 million grant to extend the program. Participants from three schools attended the STS-114 launch, and enjoyed the privilege of sitting near first lady Laura Bush in the launch viewing stands.

Twenty-two high school students participated in NASA's Summer High-school Apprenticeship Research Program for eight weeks. These students demonstrate a strong interest and aptitude in science, technology, engineering and mathematics. They worked with quality mentors from KSC colleagues representing two KSC contractors (Dynamac Corp. and the Boeing Company), and seven NASA directorates.

A Return to Flight conference with the informal education community (museums, science centers, planetariums) was jointly hosted by KSC, JSC, Marshall Space Flight Center (Alabama) and Stennis Space Center (Mississippi) at KSC to help educators engage the public throughout NASA's return-to-flight events. NASA provided tools for these informal educators to increase the public's understanding of NASA's return-to-flight process, and to incorporate into their home institutions. The 90 participants represented institutions with yearly attendance of more than seven million people.

KSC's Educator Resource Center and Exploration Station (ERC/ES) had a very dynamic year interacting with K-12 educators and students, includ-



A student prepares to measure the fin span of a spotted ray during KSC's Summer High School Apprentice Research Program.

ing those from programs such as NES and the RTF conference. KSC's educator workshops enabled 2,500 teachers to receive on-site professional development training, using NASA mission-related materials and activities to improve science- and math-related teaching. Nearly 7,600 educators received materials and information on-site at the Educator Resource Center. Additionally, Exploration Station staff reinforced the skills of nearly 20,000 students participating in 304 programs, and nearly 15,000 families participated in learning activities. ERC/ES participants also include those from local community partnerships with Delaware North Park Services, Boy Scouts of America and the Orlando Science Center. All of Brevard County's sixth-grade science teachers and 6,000 sixth-grade students participated in ERC/ES educational activities.

KSC hosted the national conference for NASA's Network of Educator Astronauts for 160 educators contending to become NASA astronauts. The finalists attended the four-day conference, updating their professional skills and NASA knowledge with workshops, tours and education kits that included a space shuttle tile for their schools. The top 35 candidates returned for the STS-114 launch.

The Aerospace Education Services Program supported KSC's region of Florida, Georgia, Puerto Rico and the Virgin Islands, providing programs for more than 22,000 educators, K-12 students and family groups. Program representatives also visited KSC's 15 NASA Explorer Schools to provide classroom instruction and family involvement activities.

For the third year, KSC and the University of Central Florida co-hosted the 2005 Florida FIRST (For Inspiration and Recognition of Science and Technology) Robotics Competition. FIRST demonstrates how mastering science and technology can enrich the lives of everyone. External studies found that 41 percent of FIRST alumni, including women and minorities, select engineering as a major. This is roughly seven times the average among college students in a national U.S. Department of Education study.

Community Outreach Programs for Education reach across many facets of Central Florida, responding to community-driven, unplanned requests for various types of support. KSC recently supported 34 elementary, three regional and two state (Florida and Georgia) science fairs, and national and local space and engineering events such as National Space Day.

Through this summer's education programs and grants, KSC benefited from the skills of 103 university interns and faculty members. In addition to being rich in ethnic diversity, this talent pool represented 66 colleges and universities, 26 college majors and 27 states. Participants worked on KSC technology development and applied research tasks. KSC hired three undergraduate interns and one of the six National Research Council post-doctoral program participants.

This summer's participants included 30 U.S. and Canadian students who were part of NASA's Spaceflight and Life Sciences Training Program, which attracts collegians interested in NASA-related research. They completed environmental, biological and flight projects highlighting the unique aspects of research and long-duration missions in space.

The Graduate Student Research Program hosted 12 students performing research and technology tasks. Additionally, KSC won funding to place four teams of faculty members and undergraduate and graduate students together in strategic positions across KSC to address the center's highest technology needs. Leveraged by KSC's faculty research programs, KSC hosted 22 faculty members accompanied by 15 students.

KSC's Virtual Lab is a suite of virtual microscopes. Teachers involved with its development emphasized the importance of making science

engaging, using materials that students can relate to beyond the classroom. The lab received national recognition for hands-on learning in Science Magazine's April 8, 2005 issue. It was praised for giving students a closer look at electron microscopes than textbooks can offer. The software can be downloaded from <http://virtual.itg.uiuc.edu>. The development team tested the product in three under-served area high schools, integrating one of the virtual microscopes into biology classes.

The Kennedy Launch Academy Simulation System, an interactive software program for schools that simulates a space shuttle launch countdown, is in its first year of development. Students can act as system engineers and address problems related to their studies. A middle school teacher helped develop designs and student materials. KSC will distribute a working prototype in 2006.

KSC is developing a sister Web site to its Enter the Firing Room site (<http://enterfiringroom.ksc.nasa.gov>) to highlight personnel working on the Launch Services Program.

For further details, visit [www.nasa.gov/centers/kennedy/education/index.html](http://www.nasa.gov/centers/kennedy/education/index.html).

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Students in the Spaceflight and Lunar Sciences and Technology trainee program participate in a research project in the Space Life Sciences Lab.





## OUTREACH TO THE WORLD

### KSC Visitor Complex

The KSC Visitor Complex continued to effectively spread NASA's message to more than 1.4 million guests from all over the world. This number is expected to grow as new attractions and experiences are realized from the 10-year master plan unveiled this year. Each key addition of the plan will provide the public with a deeper learning opportunity, and broaden the depth and diversity of NASA as an agency committed to space exploration as a destiny, as well as a destination.

The Visitor Complex hosted 15,000 launch viewing guests for NASA's historic return-to-flight mission, STS-114. An additional 3,000 guests watched from the U.S. Astronaut Hall of Fame. Giant screens at the main complex delivered the dramatic and exciting views of space shuttle Discovery launching from pad 39B.

After nearly two-and-a-half years in design and development, the NASA and concessionaire team celebrated the groundbreaking for the Shuttle Launch Experience. The new simulation experience will open in 2007. Only astronauts have been able to experience the sensations of a launch. But soon, guests at the Visitor Complex will share in

the excitement of a simulated space shuttle liftoff from countdown through main engine cutoff, creating lifelong memories.

The next scheduled enhancement in the master plan, NASA Central, will become the focus of design and planning. The new central hub of the Visitor Complex will provide guests with an exciting and inspirational sense of arrival at KSC.

Only 12 men have walked on the moon, but guests at the Visitor Complex can now share the experience through a new 3-D IMAX film presented and narrated by Tom Hanks. "Magnificent Desolation: Walking on the Moon" takes audiences to the lunar surface to walk alongside the extraordinary astronauts who have been there, nearly a quarter-million miles above the Earth's surface.

The retail stores located in the Orlando International Airport continue to thrive and contribute to reaching more than 25 million travelers that commute through one of the top 10 busiest airports in the country.

The U.S. Astronaut Hall of Fame maintained its focus on sharing and honoring the human and heroic experiences that belong to our astronauts. The educational programs based at the Hall of Fame museum delivered a real opportunity for more than 2,600 participants to engage in the world of an astronaut with two immersive programs: Camp KSC and the Astronaut Training Experience. Camp KSC introduced a robotics track to the program this year. The new program allowed camp attendees the use of automation and artificial intelligence as they designed, assembled, programmed and tested robots within a team environment.

The immersive Astronaut Training Experience entered its second year with total success, as participants 14 years and older spent their time in the one-day program absorbed in hands-on learning experiences. Activities included a special tour of KSC, a meeting with an astronaut, participation in a simulated space shuttle mission and classroom exercises.

The Visitor Complex hosted 6,000 sixth-grade students for Brevard Space Week in partnership with the Brevard County School Board. A new program was launched in the fall for 6,000 seventh graders who engaged in



An artist's rendering of the new Shuttle Launch Experience currently under construction at the Kennedy Space Center Visitor Complex.



The KSC News Center was a hub of activity for several days leading up to and including the day of the launch of Discovery on return-to-flight mission STS-114.

“Brevard Learning About Science and Technology” (BLAST), an Astronaut Training Experience tailored for a younger audience.

Special events at the Visitor Complex included the induction of the third class of space shuttle astronauts into the U.S. Astronaut Hall of Fame and the 30th anniversary of the Apollo-Soyuz Test Project.

## Exhibits

KSC’s Display Management Team and Kennedy Integrated Display Staff supported a total of 40 events reaching out one-on-one to nearly 439,000 visitors, mostly in the southeast region of the country. KSC’s road show explained NASA’s exciting space flight history, education programs and new science and technology programs.

Exhibits included an astronaut “spokes-mannequin” sharing information on NASA’s Technology Transfer Program and its goals; opportunities putting visitors into space through their own cameras, using realistic graphics and a mock-up astronaut in an extra-vehicular activity suit; and interpretive displays of NASA programs including Space Shuttle, International Space Station and Launch Services programs, with a focus on the Vision for Space Exploration. Displays and handout materials featured the benefits of space, spinoffs and NASA’s mission and vision.

KSC also participated in a variety of minority events including the Tuskegee Airmen Annual Convention, Exponica, and the United Third Bridge Puerto-Rican/Hispanic Festival. Other events included technical and educational conferences and air shows in the southeast such as Blue Angels in

Paradise in Key West, Suncoast Fest in St. Petersburg, the Tyndall Air Force Base Air Show in Florida and the Vidalia Air Show in Georgia.

KSC continued to work closely with NASA Headquarters and all of the other NASA centers to provide a One NASA image.

## Speakers Bureau

KSC’s Speakers Bureau reached more than 200,000 people at 423 events during the year, including 22 international and 48 national events. Approximately 236 KSC speakers participated, along with 22 NASA astronauts.

Using resources such as the new NASA mission and vision charts, a Vision for Space Exploration informational CD and several updated presentations, KSC brought the NASA message to educators, scientists, government representatives, special interest groups, industry officials and others throughout the United States and other countries.

The Speakers Bureau supported national events in Washington, D.C., Illinois, Georgia, Mississippi, Virginia, Ohio, Pennsylvania, Missouri, Michigan, North Carolina, South Carolina, Texas, New York, Colorado, California, Arkansas, Nevada and Iowa. The group supported international events in Bermuda, Colombia, India, England, Puerto Rico, Canada, Portugal, Italy and Australia.

KSC’s speakers brought the NASA message to minority groups including Hispanic and Asian-American groups and the Tuskegee Airmen Annual Convention.

Speakers also presented to library, university and retirement community groups, women leader-



Near the countdown clock at the KSC News Center, members of the press, photographers and press site volunteers view the launch of Space Shuttle Discovery on return-to-flight mission STS-114, on July 26, 2005.

ship programs, girls in math and science programs, engineering and science organizations, aerospace groups, education and business conferences, church and scouting groups, and numerous corporations.

### **KSC Web site and NASA Direct!**

KSC's Internet outreach continued to capture the public's attention with coverage of five expendable launch vehicle missions. Mission pages, Web broadcasts and Virtual Launch Control Center sites were developed and managed for Swift, Deep Impact, DART, NOAA-N and the Mars Reconnaissance Orbiter, in addition to a GOES-N Web broadcast requested by and produced for Goddard Space Flight Center.

The biggest event was the STS-114 return-to-flight mission. The center managed the agency's official return-to-flight Web site for several weeks prior to launch, as well as after landing, and produced hundreds of news updates and dozens of feature stories, videos and image galleries.

A record 2.8 million visitors tuned in to watch events on NASA TV online during the two-week mission. On launch day, Internet users simultaneously watched approximately 439,000 webcast streams of NASA TV and returned en masse to watch 394,500 streams of Discovery's landing in California.

Kennedy's Virtual Launch Control Center was especially popular on both launch and landing days. On landing day, this single Web page received a total of nearly 1.9 million page views, nearly four times the number of views received by the entire Kennedy Web site for the launch of STS-113 on Nov. 23, 2002. And during a 15-hour period, the six

landing-related videos in the VLCC were played an average of 429 times per minute.

### **Media Services**

The Media Services Division at KSC's NASA News Center increased public awareness and support of space programs by interfacing with the world's media and public audience through a wide variety of avenues. This included a television affiliate for NASA TV that broadcasts all NASA space shuttle and rocket launches, a World Wide Web operation which includes live webcasts, television streams and on-demand videos and a full-service Public Affairs Office catering to all forms of professional journalists.

During the year, more than 97,000 multimedia products were produced, including fact sheets, press releases, video news releases, live and radio phone-in interviews, still photographs, video footage of activities, tapes, CDs and DVDs.

The year was highlighted by the coordinated public affairs effort for NASA's space shuttle return-to-flight mission STS-114 in July, in which 2,600 media representatives were accredited from all the world's major media outlets. The space shuttle launch was broadcast live to an American audience in high-definition television and an estimated 500 million people viewed the launch on either TV or on the Web. Along with this event, media services hosted media for seven expendable launch vehicle launches and numerous local and national events hosted at the world's largest space port. Along with these activities, more than 190 media visits were hosted supporting movies, documentaries, magazines and news articles during the year.

> In the stands at KSC's Banana Creek viewing site, First Lady Laura Bush (center) watches Launch Pad 39B for the liftoff of Space Shuttle Discovery on return-to-flight mission STS-114. She is flanked by astronaut Scott Altman at left and Florida Gov. Jeb Bush at right. Sitting in front of astronaut Altman is Michael O'Brien, NASA Headquarters assistant administrator of the Office of External Relations. In front of Gov. Bush is Woodrow Whitlow Jr., former KSC deputy director.







## 2005 KSC BUSINESS REPORT

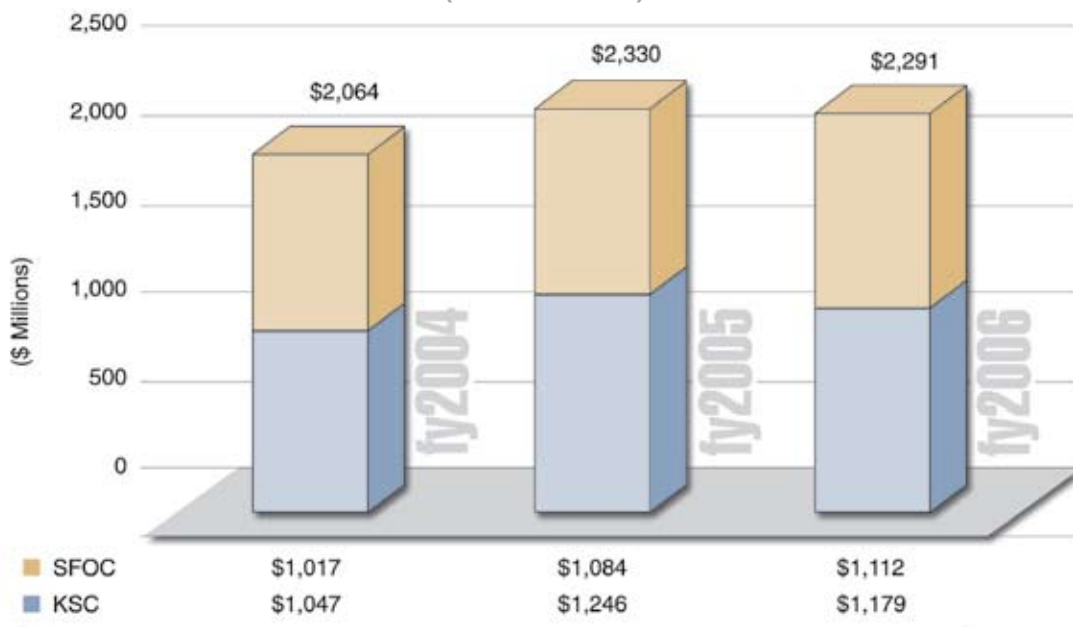
Much like the previous year, FY 2005 saw many changes in the conduct of financial operations. Full cost procedures were implemented throughout the agency in FY 2004, with many of the lessons learned during that year applied to FY 2005. KSC continued to increase its budget allocation for the fifth straight year. Our financial systems continue modification, with much of the year spent developing and testing a new, standard breakdown structure throughout the agency and new labor distribution system. At the agency level, NASA continues to seek a clean financial opinion from independent auditors. Locally, the Office of the Chief Financial Officer prepared to support KSC's role in the Vision for Space Exploration through the conduct of strategic planning efforts, enhanced customer ser-

vice and business process improvements by applying Six Sigma methodologies.

### Financial Highlights

The KSC budget in FY 2005 totaled \$1.246 billion. When including the Johnson Space Center-managed Space Flight Operations Contract work performed at KSC, together with other NASA centers' contract work, this number nearly doubles KSC's spending authority to more than \$2.3 billion. This was an increase of \$266 million over the FY 2004 level. In addition, the center had 111 active reimbursable agreements in FY 2005, accounting for an added \$206 million in commercial/other government work.

**NASA/KSC BUDGET AUTHORITY SUMMARY**  
FY 2004 thru FY 2006  
(\$ in Millions)



United Space Alliance (USA) is the contractor for the Space Flight Operations Contract at Kennedy Space Center. The space shuttle processing work is managed by Johnson Space Center and performed at KSC. The FY2004 numbers are actuals and FY2005 and FY2006 are the President's budget.



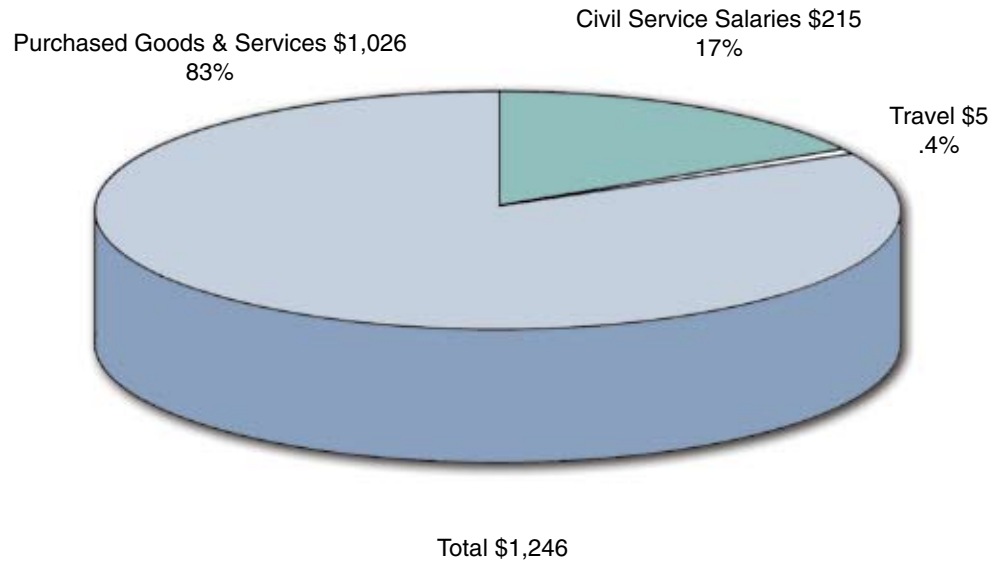
**KENNEDY SPACE CENTER  
FY 2005 BUDGET AUTHORITY  
(\$ in Millions)**

Space Shuttle	\$561
Space Science	\$319
Space Station	\$142
Space and Flight Support	\$142
Exploration Systems	\$62
Education	\$3
Corporate G & A	\$17
<b>Total KSC</b>	<b>\$1,246</b>

- The Space Shuttle Program's return to flight increased its FY 2005 budget by more than \$150 million over the previous year.
- International Space Station funding showed a 9 percent increase in FY 2005.
- The Launch Services Program continued supporting the agency's science missions at a budget level of \$40 million over FY 2004.
- The Exploration Program, funded at a modest \$62 million in FY 2005, is expected to significantly increase over the next several years, a good sign for KSC's future work expectations.
- Included in the FY 2005 funding was \$126 million in an emergency supplemental appropriation to repair damaged assets resulting from last year's hurricanes, and to increase protection against future storm damage on many of the facilities at the center.
- KSC remains an economical place to conduct business. The center's general and administrative rate is the lowest in the agency.

ksc business

## NASA/KSC BUDGET AUTHORITY SUMMARY FY 2005 (\$ in Millions)



NASA continues progressing toward receiving a clean audit opinion on its annual financial statements. One of the material weaknesses identified by the auditors is NASA's valuation of "property, plant and equipment." The agency is currently developing compensating controls which will strengthen NASA's ability to validate this valuation, and ultimately lead to clean audit opinions in the near future.



## FINANCIAL SYSTEMS

The conversion of all NASA centers to a single financial system is the major component of NASA's progress in the "improve financial management" element of the President's Management Agenda. Among the FY 2005 changes within the Integrated Financial Management Program is its name change to the Integrated Enterprise Management Program. The title change was made to highlight the fact that this major overhaul of the agency's information and data systems goes well beyond the involvement of those in the financial world.

The last half of FY 2005 was heavily involved with implementing two new modules in this program. Project Management Information Improvement (PMI2) will provide a consistent work breakdown structure across the agency for labor, travel and technical project management. PMI2 was a demanding effort that engaged the entire center and affected every civil servant who records employment time, travels or works on a project. As such, a rigorous "change management" effort was involved, which included directives from the administrator, a series of town hall meetings featuring our center director, and numerous other events to prepare for this massive change. The second new module is the Agency Labor Distribution System (ALDS), which is an extension of the current financial system that captures labor costs at the employee level. The ALDS creates a single agency system of record for labor distribution and retires 10 different center labor distribution systems. The purpose of both new systems is to improve management decision-making through better information.

## BUSINESS PROCESS IMPROVEMENT

Six Sigma is an improvement method that applies a rigorous model to define, measure, analyze, improve and control a process. The Six Sigma metric is the result of comparing the output of the business process with customer requirements. By the close of FY 2005, the Office of the Chief Financial Officer had applied Six Sigma to four business processes: civil service travel, contractor cost analysis,

procurement request generation and civil service labor collection. Metrics will continue to be measured over time; early results are promising.

The role of Center Business Process Lead really found its place during this fiscal year, leading the implementation of PMI2 across the center, directing the procurement request process improvement activity, and serving as a liaison between KSC users, the Integrated Enterprise Management Program and its Competency Center. The agency's Center Business Process Lead summit, hosted by KSC last June, showcased the fact that KSC is among NASA's leaders in implementation, operations and process improvement.

## STRATEGIC PLANNING

Finally, this year KSC made great strides in transformation within the Office of the Chief Financial Officer to develop a "Vision for 2010," which included establishing financial goals, business process improvement, full service to the center's customers, and business partnerships with KSC stakeholders as the agency transforms and prepares to make the Vision for Space Exploration a reality. The office has chosen "Making Dollars Make Sense" as the representation of its vision.

## ECONOMIC IMPACT

To fulfill its mission, NASA requires an extraordinary range of commodities including liquid and gaseous propellants, rocket engines, computers and photographic equipment. The range of services purchased is just as wide, including communications, laboratory testing, space shuttle processing, payload integration and testing and expendable launch services. In meeting NASA's demand for these goods and services, local contractors employ workers, produce products, fund payrolls and generate output. These workers and contractors generate additional impacts as they spend their incomes and place orders with other regional firms for materials and services. Each round of such spending recirculates NASA's initial demand among Florida's businesses and households, multiplying the direct impact on the economy.

A number of other activities directly associated with NASA also add to the total economic impact in Florida. These include the local travel expenditures of out-of-state business and government personnel

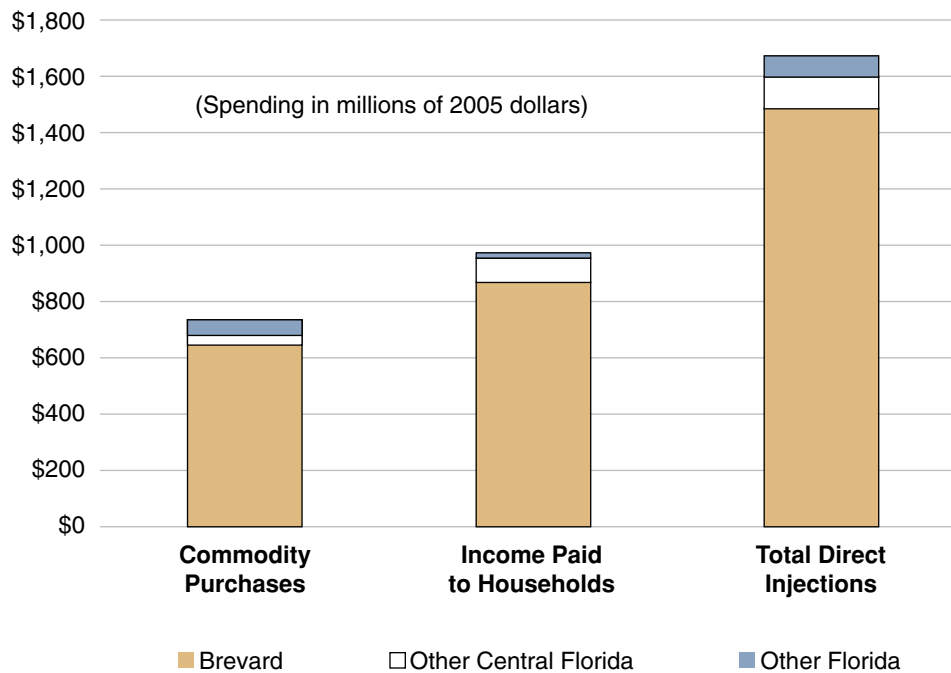
that travel to KSC to conduct business, KSC Visitor Center's sales to out-of-state visitors, and the federal, state and local taxes these sales generate.

KSC annually conducts an Economic Impact Analysis to measure NASA's effect on the economy at the local, regional and state levels. Since 2002, the report has been conducted by the Transportation Economics Research Institute of Mount Dora, Fla.

In FY 2005, of the \$16.1 billion NASA budget, it is estimated that KSC and other NASA centers injected nearly \$1.7 billion into the local and state economies of Florida. This spending set off a cycle of economic transactions that flowed throughout many sectors of these economies and created a multiplied level of total economic activity that far exceeded NASA's initial injection. This multiplied "NASA effect" results in a total economic impact of \$3.7 billion in the state of Florida. This represents the fourth year of consecutive increases since the report was initiated in its current form.



**TOTAL INJECTIONS INTO FLORIDA ECONOMIES BY KSC/NASA  
ACTIVITIES SPENDING, LOCAL TRAVEL EXPENDITURES OF KSC  
BUSINESS VISITORS AND KSC VISITOR CENTER PURCHASES  
BY OUT-OF-STATE VISITORS FY 2005**

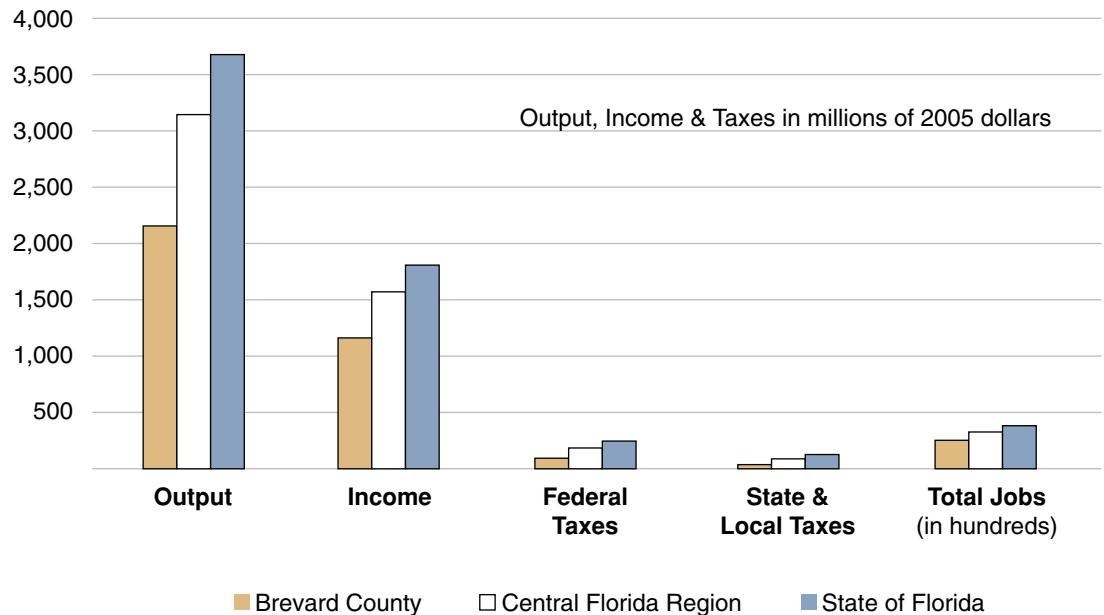


	Brevard	Other Central Florida	Other Florida	Florida Total
Commodity Purchases	\$627	\$32	\$58	\$716
Income Paid to Households	\$854	\$85	\$19	\$958
Total Direct Injections	\$1,481	\$116	\$77	\$1,674

In FY 2005, all KSC/NASA activities injected \$1.67 billion of outside money into Florida's economy. This total consisted of \$958 million in direct earnings payments to households and \$716 million in direct commodity purchases from contractors. Ninety-five percent of the total injection went to Central Florida businesses and households.

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## THE TOTAL ECONOMIC IMPACT OF ALL NASA ACTIVITIES AT KSC ON FLORIDA BY GEOGRAPHIC AREA FY 2005



Area of Economic Impact	Output	Income	Federal Taxes	State & Local Taxes	Total Jobs
Brevard County	2,196	1,184	72	23	21,000
Central Florida Region	3,168	1,554	167	69	31,800
State of Florida	3,680	1,758	187	85	35,000

In FY 2005, economic modeling showed a total NASA economic impact in Florida of nearly \$3.7 billion, including \$1.8 billion in household income driven by the net creation of 35,000 jobs throughout the state, including the KSC population. NASA activity also generated \$272 million of federal, state and local taxes. Eighty-six percent of the economic output and 91 percent of the employment occurred within Central Florida.



## WORK FORCE DIVERSITY

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 KSC.

The work force is a diverse group of people dedicated to supporting the nation's space program and the Vision for Space Exploration. To accomplish the various missions expected of the Space Center, 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 fed-

eral and contract employees chartered to work for KSC. 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 September 30, 2005, the total KSC population was 14,595. This includes 2,074 full-time and other-than-full-time NASA civil servants and 10,894 total on-site and off-site contractor employees. The civil servant skill mix includes scientific and engineering, administrative, technical and clerical workers. There are 557 construction employees, with 1,070 tenants on the center.

### KENNEDY SPACE CENTER WORK FORCE PROFILE (through 9/30/05)

On Duty Full-Time Civil Service	1,797
On Duty Other Than Full-Time Civil Service	277
<b>Total Civil Servants</b>	<b>2,074</b>
<b>Civil Servant Skill Mix</b>	
Scientific & Engineering	60%
Administration	25%
Technical	9%
Clerical	6%
On-Site Contractor Employees	10,340
Off-Site Contractor Employees	554
<b>Total Contractor Employees</b>	<b>10,894</b>
<b>Total Construction Employees</b>	<b>557</b>
<b>Total Tenants</b>	<b>1,070</b>
<b>TOTAL KSC POPULATION</b>	<b>14,595</b>

### **Industry Partners at a Glance**

The companies listed below were KSC's top support contractors or Launch Services contractors in terms of dollars obligated in FY 2005. Following is a brief description of their work for the agency:

#### **United Space Alliance (USA)**

Under a Johnson Space Center contract, USA is the prime contractor for the Space Flight Operations Contract. USA's primary purpose is to ensure mission success for the Space Shuttle Program. KSC is the primary point of responsibility for launch and landing of the space shuttle. USA supports ground operations and orbiter logistics elements of the Space Shuttle Program at KSC.

#### **Space Gateway Support (SGS)**

SGS, a joint venture of Northrop Grumman and Wackenhut, provides base operations support for KSC and Cape Canaveral Air Force Station. SGS is responsible for such activities as roads and grounds maintenance, facilities maintenance, custodial services, fire protection, security, calibrations, and propellants handling.

#### **The Boeing Company**

The Boeing Space Operations Company is the prime contractor for the Checkout, Assembly and Payload Processing Services (CAPPS) contract. Its primary purpose is to support payload processing for the International Space Station, space shuttle, and expendable launch vehicles (ELVs). Boeing performs all aspects of payload processing, including planning and receiving payloads, maintaining associated payload ground systems, integrating payloads with the space shuttle, launch support and space shuttle post-landing payload activities.

#### **InDyne, Inc.**

InDyne, Inc. provides communication services under the KSC Integrated Communications Contract (KICS) supporting the space shuttle, payload car-

riers, launch services and the International Space Station. InDyne provides hardware and software integration and development for voice, video and data communications. InDyne also provides motion picture, still photography, digital and video products and services for NASA, the U.S. Department of Defense and commercial ELV customers. InDyne handles the operation, administration and maintenance of the administrative telephone system in support of all KSC residents.

#### **Analex, Inc.**

Analex is the prime contractor on the ELV Integrated Support contract. The contractor is 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 include managing, operating, maintaining and sustaining engineering of the NASA ELV communications and telemetry stations located at Cape Canaveral Air Force Station and Vandenberg Air Force Base in California, along with assigned NASA facilities, systems, and equipment at Vandenberg. The company performs engineering services/studies and technical services for various ground/flight ELV systems, missions and payloads.

#### **The Arctic Slope Research Corporation (ASRC) Aerospace**

ASRC Aerospace provides research and engineering services and technical support to the KSC Spaceport Engineering and Technology organization and other operational customers at the center. The support includes providing research, engineering development and management of complex research and development and technology projects. The company also provides engineering and technical support of various KSC laboratories and test beds. ASRC Aerospace uses a group of affiliated universities in performing applied research and technology development efforts. ASRC Aerospace also

provides technology outreach to foster awareness and use of capabilities that are unique to KSC.

### **Dynamac Corporation**

The Life Sciences Services Contract provides a broad range of life sciences services to NASA. These include medical operations for shuttle and space station programs, environmental compliance and stewardship, life sciences payload operations and development, support to the Agency Occupational Health Program Office, biological science, work force protection, fitness and musculoskeletal rehabilitation, and education outreach.

### **The Boeing Company**

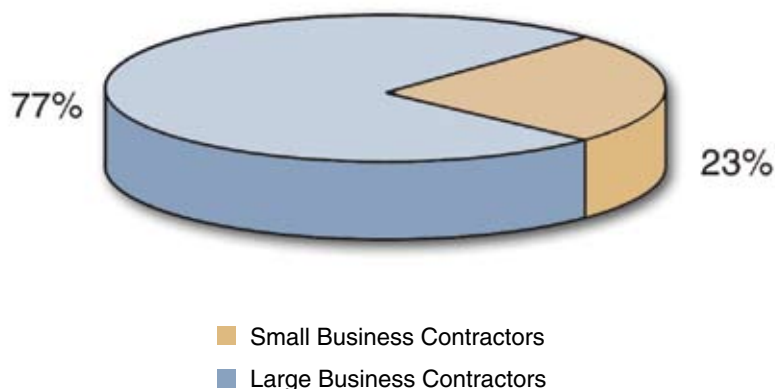
Delta Launch Services, Inc. provides NASA with launch services using its Delta II vehicle. Boeing is the contractor for one of three existing NASA Launch Services multiple-award Indefinite Delivery Quantity task order contracts. Principal location for the Delta II vehicle assembly is in Decatur, Ala. The Delta II vehicles launch from Cape Canaveral Air Force Station and Vandenberg.

### **Lockheed Martin Company**

Lockheed Martin Commercial Launch Services, Inc. provides the agency with launch services using its Atlas vehicle. Lockheed is the contractor for one of three NASA Launch Services multiple-award Indefinite Delivery Quantity task order contracts. Principal location for the Atlas vehicle assembly is in Denver. The Atlas vehicles launch from Cape Canaveral and Vandenberg.

### **Orbital Sciences Corporation (OSC)**

Orbital Sciences Corporation provides NASA with launch services using its Pegasus and Taurus small expendable launch vehicles launched from Cape Canaveral, Vandenberg, Wallops Flight Facility in Virginia, and equatorial launch ranges. OSC is the contractor for one of three NASA Launch Services multiple-award Indefinite Delivery Quantity task order contracts. Additionally, OSC provides Pegasus and Taurus vehicles to the agency under a second contract, the Small Expendable Launch Vehicle Contract.





## YOUR PROCUREMENT DOLLARS AT WORK

### GEOGRAPHICAL DISTRIBUTION BY STATE (FISCAL YEAR 2005 OBLIGATIONS)

State	Total (\$K)	State	Total (\$K)
ALABAMA	498	NORTH DAKOTA	24
ARKANSAS	24	NEBRASKA	23
ARIZONA	27,104	NEW HAMPSHIRE	410
CALIFORNIA	18,934	NEW JERSEY	975
COLORADO	1,312	NEW MEXICO	167
CONNECTICUT	13,482	NEVADA	6
DISTRICT OF COLUMBIA	56	NEW YORK	514
DELAWARE	51	OHIO	1,569
FLORIDA	1,046,989	OKLAHOMA	69
GEORGIA	1,571	OREGON	84
HAWAII	16	PENNSYLVANIA	1,323
IOWA	42	PUERTO RICO	0
ILLINOIS	882	RHODE ISLAND	206
INDIANA	4	SOUTH CAROLINA	203
KANSAS	410	SOUTH DAKOTA	33
KENTUCKY	242	TENNESSEE	71
LOUISIANA	175	TEXAS	2,609
MASSACHUSETTS	2,609	UTAH	31
MARYLAND	6,082	VIRGINIA	4,791
MICHIGAN	712	WASHINGTON	32
MINNESOTA	140	WISCONSIN	1,446
MISSOURI	75		
MISSISSIPPI	6,196		
NORTH CAROLINA	750		
		<b>TOTAL</b>	<b>1,142,939</b>

## TOP 25 KSC BUSINESS CONTRACTORS FOR FISCAL YEAR 2005

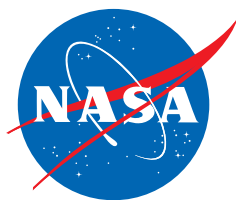
Contractor Obligated	Number of Contracts/Orders	Dollars (in Thousands)
The Boeing Company	12	333,664
Space Gateway Support	1	322,392
Lockheed Martin Corp.	1	114,140
InDyne, Inc.	1	58,825
Met-Con	1	39,423
Analex Corp.	1	37,018
ASRC Aerospace Corp	2	28,604
Orbital Sciences Corp.	2	26,626
Dynamac Corp.	4	20,169
Air Liquide America Corp.	1	8,648
Praxair, Inc.	2	7,800
Cendant Mobility Services Corp.	1	6,656
Rush Construction, Inc.	3	6,475
Rush Peak Joint Venture	8	5,460
Sauer, Inc.	6	4,425
All Points Logistics, Inc.	3	3,635
Chrome Electric Inc.	6	3,288
AstroTech Space Operations Inc.	4	3,255
Seyforth Roofing Co. Inc.	1	3,011
Infinite Energy, Inc.	1	2,840
Spades Contractor, Inc.	1	2,723
David A Boland, Inc.	1	2,481
Reynolds, Smith and Hills, Inc.	2	32,124
OA0 Corp.	2	11,988
American Remote Vision Co.	1	68
<b>TOTAL</b>	<b>108</b>	<b>1,045,737</b>

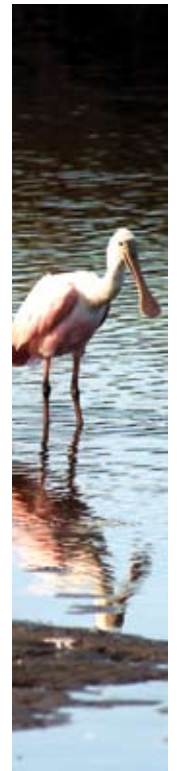
Johnson Space Center's Space Flight Operations Contract held by United Space Alliance recorded \$796.94 million managed by the KSC Procurement Workforce in FY 2005.

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