

# Kennedy Space Center's Annual Report FY2006



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NASA explores for answers that power our future.



# Center Director's Message



During 2006, Kennedy Space Center's one-of-a-kind work force continued to launch successful space shuttle and expendable launch vehicle missions, processed a full complement of elements and hardware for delivery to the International Space Station, and played a strategic part in setting the course for NASA's next steps in the Constellation Program and the Vision for Space Exploration.

Two successful space shuttle launches delivered crucial truss elements to expand the space station's capabilities. Three liftoffs of expendable launch vehicles carried new and unique spacecraft to study distant planets, as well as our own.

In order to prepare for the challenges of the future, KSC created four new offices that will be essential to making a smooth transition from the shuttle to the new exploration program. These are the Constellation Project Office, the Engineering Development Directorate, the Applied Technology Office and the Advanced Planning Office.

KSC's employees embody the spirit of the community in which they live by reaching out to support local charities through the Combined Federal Campaign and other programs. The center also continues to value its partnerships, and promotes education outreach and technological excellence as together we prepare to send humans back to the moon, then on to Mars and beyond.

Through these and many other accomplishments in 2006, KSC continued playing a key role in the future of human spaceflight and in helping to better understand the universe in which we live.

I invite you to read more about our nation's gateway to exploring, discovering and understanding our universe in the pages that follow in this annual report.

Working together, I believe that our best days are ahead of us.

Sincerely,

A handwritten signature in black ink, appearing to read 'William W. Parsons'. The signature is fluid and cursive, with a large loop at the beginning and a long, sweeping tail.

William W. Parsons  
Center Director

A fish-eye view from inside the Vehicle Assembly Building shows Space Shuttle Discovery as it begins its slow 4.2-mile journey via the crawlerway to Launch Pad 39B, for launch on July 4, 2006.

# NASA Vision and Mission

## NASA'S MISSION

NASA continues the American traditions of pioneering, exploration and expanding the realm of what is possible by using unique competencies in science and engineering to fulfill the agency's purpose and achieve NASA's mission:

**To pioneer the future in space exploration,  
scientific discovery, and aeronautics research.**

## THE VISION FOR SPACE EXPLORATION

On Jan. 14, 2004, President George W. Bush announced "A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration," a new directive for the nation's space program, and it was endorsed by Congress in the NASA Authorization Act of 2005.

This directive committed the nation to a journey of exploring the solar system, returning astronauts to the moon in the next decade, then venturing to Mars and beyond.

NASA established six strategic goals to help achieve the Vision for U.S. Space Exploration:

- Fly the shuttle as safely as possible until its retirement, not later than 2010.
- Complete the International Space Station in a manner consistent with NASA's international partner commitments and the needs of human exploration.
- Develop a balanced overall program of science, exploration and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.
- Bring a new Crew Exploration Vehicle into service as soon as possible after shuttle retirement.
- Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.
- Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

# NASA Values

NASA is privileged to take on missions of extraordinary risk, complexity and national priority. The agency's employees recognize their responsibilities and are accountable for the important work entrusted to them. They strive to achieve an uncompromising standard of technical excellence in a healthy and safe environment.

The agency's four shared core values support NASA's commitment to technical excellence and express the ethics that guide the agency's behavior. The following values are the underpinnings of NASA's spirit and resolve:

## SAFETY

NASA's constant attention to safety is the cornerstone upon which NASA builds mission success. NASA employees are committed, individually and as a team, to protecting the safety and health of the public, NASA team members, and the assets that the nation entrusts to the agency.

## TEAMWORK

NASA strives to ensure the agency's work force functions safely at the highest levels of physical and mental well-being. NASA's most powerful tool for achieving mission success is a multi-disciplinary team of competent people. The agency builds and values high-performing teams that are committed to continuous learning, trust and openness to innovation and new ideas.

## INTEGRITY

NASA is committed to maintaining 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.

## MISSION SUCCESS

NASA's purpose is to conduct successful space missions on behalf of the nation and to explore, discover and learn. Every NASA employee believes that mission success is the natural consequence of an uncompromising commitment to technical excellence, safety, teamwork and integrity.

# Significant Events

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1. Oct. 6, 2005  
Inside the Orbiter Processing Facility, engineers cheer as electricity courses through Endeavour for the first time in two years, signaling the end of the orbiter's major modification period.
2. Oct. 6, 2005  
Kennedy Space Center creates four new offices in response to the Exploration Systems Architecture study, which aims to implement the nation's Vision for Space Exploration. These are the Constellation Project Office, the Engineering Development Directorate, the Applied Technology Office and the Advanced Planning Office.
3. Oct. 7, 2005  
NASA and Zero Gravity Corp., also known as ZERO-G, announce the firm's participation in a pilot program at KSC to conduct commercial flights from the Shuttle Landing Facility.
4. Oct. 21, 2005  
KSC's chief medical officer, Dr. Irene Long, is one of three women in the agency honored at the Women of Color Technology Awards Conference in Atlanta.
5. Oct. 24, 2005  
KSC closes for business and operations due to the threat from Hurricane Wilma. The center's employees return to work on Oct. 26.
6. Nov. 4, 2005  
KSC provides local students and job seekers with disabilities an opportunity to spend a day at the center in support of National Disability Employment Awareness Month.
7. Jan. 13, 2006  
KSC marks the 40th anniversary of the use of crawler transporters in advancing spaceflight. Dating back to use in the late 1960s to transport the Apollo/Saturn launch vehicles to the pad, crawlers have transported the space shuttle atop the mobile launcher platform to Launch Complex 39 for all of NASA's shuttle missions.

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8. Jan. 19, 2006  
NASA's New Horizons spacecraft, the first mission to distant dwarf planet Pluto, gets under way after a successful launch aboard an Atlas V from Launch Complex 41 at Cape Canaveral Air Force Station, Fla.
9. Jan. 24, 2006  
William (Bill) Parsons is named the new deputy director of Kennedy Space Center. He becomes the center's ninth center director in January 2007, upon James W. Kennedy's retirement.
10. Feb. 8, 2006  
The Virgin Atlantic Airways GlobalFlyer aircraft, piloted by Steve Fossett, takes off from KSC's Shuttle Landing Facility at 7:22 a.m., beginning its record-breaking, non-stop trek around the world.
11. March 22, 2006  
The Space Technology-5 spacecraft launches from a Pegasus XL from Vandenberg Air Force Base, Calif. Part of NASA's New Millennium Program, the ST-5 consists of three miniature spacecraft called "micro-sats."
12. March 24, 2006  
KSC's management and local industry officials participate in a ribbon-cutting ceremony for the new Operations Support Building II in the Launch Complex 39 area.
13. March 29, 2006  
NASA and HDNet work together to provide high-definition TV coverage of space shuttle liftoffs and landings and expendable launch vehicle launches at KSC through 2010.
14. April 6, 2006  
NASA launches a series of events to commemorate the 25th anniversary of the first space shuttle flight on April 12, 1981, aboard Columbia. KSC's Launch Control Center Firing Room 1 is renamed and dedicated the Young-Crippen Firing Room in honor of the first shuttle crew, Commander John Young, at right in photo, and Pilot Robert Crippen.

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15. April 28, 2006  
The CALIPSO/CloudSat satellites launch aboard a Delta II vehicle from Vandenberg Air Force Base. Both satellites will provide new information on the effects of clouds and airborne particles to help scientists understand changes in the Earth's climate and weather.
16. May 31, 2006  
The European Space Agency's research laboratory, Columbus, arrives at KSC's Space Station Processing Facility, where it will be prepared for delivery to the International Space Station on a future space shuttle mission.
17. June 2, 2006  
The crew of mission STS-121 arrives at KSC to participate in a full launch dress rehearsal and other prelaunch activities called the terminal countdown demonstration test.
18. June 2, 2006  
NASA selects Lockheed Martin Commercial Launch Services Inc. to deliver an Atlas V rocket for the Mars Science Laboratory mission, scheduled for launch in September 2009.
19. July 4, 2006  
Providing its own version of fireworks, the seven-member crew of mission STS-121 launches on Space Shuttle Discovery from Launch Pad 39B at 2:37 p.m. on a mission to the International Space Station. This marks the first space shuttle launch on Independence Day and the first launch countdown from the Launch Control Center's newly renovated Firing Room 4.
20. July 17, 2006  
Space Shuttle Discovery safely lands at 9:14 a.m. at the Shuttle Landing Facility after a 13-day, five-million-mile journey in space.

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21. Aug. 21, 2006

KSC Director Jim Kennedy announces the appointment of Patrick Simpkins as director of the center's new Engineering Directorate.

22. Aug. 29, 2006

KSC closes at midnight as Tropical Storm Ernesto closes in on the Space Coast. Space Shuttle Atlantis begins a trek from Launch Pad 39B to the Vehicle Assembly Building, but half-way to the VAB, a decision is made to return the shuttle to the pad as forecasts improve. With no damage to hardware or facilities, KSC returns to normal operations on Aug. 31.

23. Sept. 9, 2006

Space Shuttle Atlantis and its six-member crew launch on mission STS-115 at 11:14 a.m. from Launch Pad 39B, bound for the International Space Station.

24. Sept. 12, 2006

NASA Administrator Michael Griffin names William (Bill) Parsons the new director of KSC, effective in January 2007.

25. Sept. 21, 2006

Space Shuttle Atlantis and its crew return home to Florida after a 12-day, 4.9-million-mile journey in space, marking the success of mission STS-115 in restarting assembly of the International Space Station.

# Space Shuttle Processing

Just as NASA's astronauts need the fleet of orbiters to accomplish their work in space, the agency relies on a team of experts who prepare Atlantis, Discovery and Endeavour for flight on each mission. Kennedy Space Center's NASA and contractor processing work force has prepared the vehicles for launch since the Space Shuttle Program's first launch in 1981.

During the fiscal year, orbiters for three missions to the International Space Station were processed in bays in the Orbiter Processing Facility and mated to their external tank and solid rocket boosters inside the Vehicle Assembly Building. Two of these missions launched during the fiscal year.

A combined total of 13 astronauts traveled more than 10 million miles during missions to deliver crucial elements, supplies and equipment to the International Space Station, bringing the agency one step closer to completing the orbiting laboratory as the center prepares for the first test flight of the Ares I launch vehicle in 2009.

## SPACE SHUTTLE MISSIONS

### Mission STS-121

Space Shuttle Discovery on mission STS-121 carried seven astronauts and a multi-purpose logistics module with supplies and equipment to the station. The launch on July 4, 2006, at 2:37 p.m. created its own form of fireworks as it became the only mission in the history of the program to launch on Independence Day.

Significant processing work was performed in order to prepare Discovery for its 32nd flight, including 42 vehicle modi-

fications, 354 tile replacements and more than 100 special tests. The STS-121 mission succeeded in testing shuttle safety improvements, repairing a rail car on the space station and producing the first high-resolution images of the shuttle during and after its launch. Discovery landed safely at KSC on July 17, at 9:14 a.m., after a 13-day mission.

### Mission STS-115

Space Shuttle Atlantis launched on mission STS-115 carrying six astronauts at 11:14 a.m. Sept. 9, 2006. The mission resumed assembly of the space station by delivering the massive P3/P4 truss segment, an integral part of the station's backbone, and two sets of solar arrays.

The mission was memorable even before launch, marking the first time in the program's history that the shuttle rolled halfway back from the launch pad to the Vehicle Assembly Building due to tropical storm Ernesto, then rolled back to the pad as Ernesto fizzled out. STS-115 tested not only KSC's hurricane rollback procedures, but also the lightning strike inspection and retest procedures. After a 12-day mission, Atlantis landed at KSC at 6:21 a.m. on Sept. 21.

## SPACE SHUTTLE PROGRAM ACCOMPLISHMENTS

### Hurricane Katrina National Liquid Hydrogen Shortage: Transfer of NASA/KSC Stock

In August 2005, Hurricane Katrina caused severe damage to Air Products and Chemicals Inc., a liquid hydrogen production plant in New Orleans. This loss of production resulted in a nationwide critical shortage of liquid hydrogen, or LH2. The president and chief executive officer of Air Products requested that NASA sell any available inventory of liquid hydrogen back to the company to support industries, including power generation for nuclear plants, metals processors, glass and electronics producers and chemical processors. The Space Shuttle Program agreed to allow a KSC and Air Products team to transfer 660,000 gallons back to Air Prod-

Ironworkers from Ivey's Construction attach a new lightning mast tower to beams at the 295-foot level of the Fixed Service Structure on Launch Pad 39A.



Inside the Vehicle Assembly Building, scaffolding is positioned on the vertical lift doors work platform at the 400-foot level to allow workers access. The platform weighs more than 200 tons and was lifted into place by a crane.

ucts to support the needs of the nation. Engine testing operations at the Stennis Space Center were also curtailed.

As recorded in the U.S. Congressional Record on Dec. 5, 2006, "NASA's generous actions allowed for the continued, albeit reduced, supply of liquid hydrogen to most commercial customers across the United States and prevented the shutdown of numerous manufacturing facilities and commensurate job losses throughout the nation."

### Bird Abatement Program

As the result of a bird strike during the STS-114 launch, KSC researched, developed and implemented several measures to reduce the possibility of bird strikes on future missions. DeTect Inc. in Panama City, Fla., designed and built the radar unit which consists of two basic marine radar devices that scan in the vertical and horizontal planes. The radar is used as a detection tool and provides the launch team with critical information on the presence of birds or vultures before a launch. The center established a "Roadkill Roundup" program encouraging workers to contact a hotline number to report locations of dead animals for removal, thereby removing the food sources for large birds.

### Launch Pad 39A Improvements

After two-and-a-half years, the multi-million-dollar construction efforts to upgrade and strengthen the ground systems on Launch Pad 39A are complete. Modifications included removing Apollo and early shuttle program items that are no longer used, installing an enhanced post-launch washdown system, and strengthening the rotating service structure to support additional weight. More than 526,000 square feet of the pad's fixed and rotating service structures were sandblasted and repainted to eliminate corrosion and foreign object debris sources. Upgrades to existing facilities began in November 2004 and were completed by February 2007.

More than 60 large and small projects were completed. The most significant was the Integrated Network Control System modification, which replaced outdated ground support hardware. These projects were completed by United Space Alliance and personnel from several companies and subcontractors.

## SPACE SHUTTLE PROGRAM UPGRADES

### Station-Shuttle Power Transfer System

Space Shuttle Endeavour recently received a major modification that allows power generated from the solar arrays on the International Space Station to supplement the orbiter's electrical power while docked. Prior to this modification, electrical



power could only be transferred from the orbiter to the station. The Station-Shuttle Power Transfer System will enable the orbiter to stay docked to the station three to six days longer than in the past by conserving valuable liquid hydrogen and oxygen normally required by the orbiter's power-generating fuel cells. These longer stays on orbit will allow for additional crew time to perform detailed thermal protection system assessments, station construction and maintenance, and science activities. The system also will provide extra power if the orbiter crew requires a rescue mission. KSC's Orbiter Electrical Engineering group was involved with the system modification from the beginning. At the outset, the group coordinated with the Boeing design center on the requirements and engineering for this modification.

### Space Shuttle Integrated Network Control System

The Launch Vehicle Processing Directorate successfully completed a total ground support equipment command and control replacement for the launch pads. The modification replaced original shuttle ground support equipment dating back to the mid-1970s.

The new architecture, called the Integrated Network Control System, communicates between the Launch Control Center and the support equipment wherever the shuttle is being processed. The project uses new technology that can support the shuttle program and prepares KSC for future launch vehicles, such as the Ares I tests and subsequent Constellation Program vehicles.

### Vehicle Assembly Building Doors Refurbishment

A refurbishment project began on the Vehicle Assembly Building's historic doors, which saw the massive Apollo Saturn V rockets and space shuttles roll out for launches. The multi-year, multimillion-dollar project started during the fiscal year.

Work was completed on the first of four high bay doors, which consist of horizontal and vertical panels that run almost the entire 525-foot height of the building. Refurbishment work on the vertical doors included replacing structural members,



< In high bay 3 of the Vehicle Assembly Building, a United Space Alliance worker attaches the external tank to one of the solid rocket boosters on the mobile launcher platform in preparation for mission STS-115.

### Crawler Transporter Shoe Nondestructive Evaluation Using Modal Vibration Methods

Modal vibration tests were used on the tread shoes of the crawler transporter for the first time in June 2006 as a cost-effective way to identify flawed shoes that could be replaced prior to total failure. These tests help to identify internal structural changes, including cracks and voids. The in-situ modal tests can be performed during shuttle rollout on suspect shoes and subsequent rechecks so the shoes can be removed and replaced to prevent a total failure.

Each of the eight tracks on a vehicle contains 57 shoes and each tread shoe weighs about 2,000 pounds. Modal experimental testing uses a special hammer to produce a wide range of vibration frequencies into the shoes, helping to create a graphic picture of each shoe's response and natural frequency. The graph of frequencies is unique to the inherent characteristics of the shoe due to differences in shape, material strength, flexibility, weight and composition. If the shoes could be consistently tested on a one-by-one basis, differences in structure could be easily established without destructive testing or even without removal from the crawler.

sandblasting, painting and installing new exterior siding. Accessing the doors required using a specially designed work platform that is 103 feet long, 70 feet wide and 69 feet tall in some places. The old 115-ft.-tall horizontal doors were removed from the building and replaced with newly built doors using three mobile cranes.



Radar technicians adjust two bird detection radars, known as Aircraft Birdstrike Avoidance Radar, near Launch Pad 39B before the July 4, 2006, launch of Space Shuttle Discovery on mission STS-121.

### NEW IMAGERY TOOLS

#### Ice Detector

The prototype ice detector unit was first used for mission STS-116, which launched on Dec. 9, 2006. Developed during fiscal year 2006, the unit is still in development by KSC engineers. The initial results were promising. The ice detector can determine the difference between ice, frost and condensation on the surface of the external tank. Ice detection is important because ice buildup could lead to a launch scrub. The ice detector is about the size of a small refrigerator.

#### 2000 mm Telescope

Also used during the STS-116 launch, a new 2000 mm telescope took images of ice that had built up on the gaseous oxygen vent duct. The telescope provided detailed images of the ice frost ramps of the external tank. One of the Final Inspection Team photographers connected a digital camera to the telescope to collect pictures from the base of the mobile launch platform. The telescope can also be used to take magnified pictures of small trouble spots on the vehicle and launch pad.

> Framed by trees in nearby woods, Space Shuttle Discovery rockets into the blue sky on July 4, 2006, from Launch Pad 39B on mission STS-121.



# International Space Station and Spacecraft Processing

Each element aboard a space shuttle for delivery to the International Space Station begins its journey at Kennedy Space Center's Space Station Processing Facility, where it undergoes final checkout, assembly and processing before flight. Preparations can take a few months or even several years to ensure that the elements are ready for delivery.

During fiscal year 2006, the center's International Space Station and Spacecraft Processing directorate provided payload processing support for two space shuttle missions and continued preparations for several future missions to the station.

## Mission STS-121 (ULF-1.1)

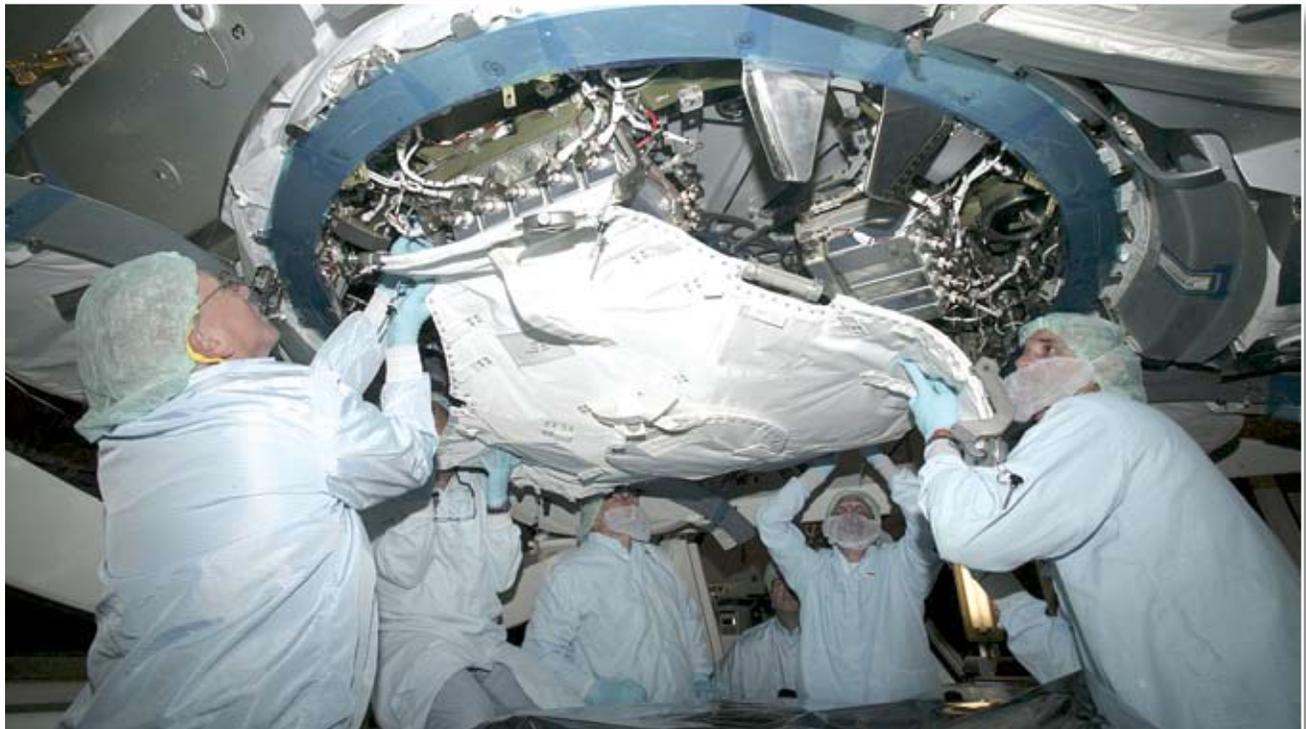
The team processed payloads for ULF-1.1, which included a multi-purpose logistics module containing an oxygen generation system, two science racks and other logistics hardware. The team also processed a new trailing umbilical system which replaced a failed unit on orbit. The umbilical system is part of the mobile transporter system attached to the space station. It controls the movement and direction of the mobile transporter as it navigates along the station's external truss system.

## Mission STS-115 (12A)

For mission STS-115, the team completed processing and demonstrated the flight readiness of the P3/P4 integrated truss segment. Processing accomplishments included final attachment of the upper-deck solar array following battery replacement, loading P3 and P4 flight software and replacing a failed P3 communication box late in the processing flow. Even with these processing challenges, the team delivered the truss segment early to the launch pad for installation in the shuttle's payload bay. The P3/P4 truss segment, with its wingspan of 240 feet, has proven a reliable source of the station's power capability. When the station is complete, this segment will provide one-fourth of the combined power from the U.S. solar arrays. Additionally, the P3 half of the truss has a mechanism to allow the rotation of all of the outboard truss segments, including the solar arrays, to allow them to stay pointed toward the sun for optimal power generation.

## Mission STS-116 (12A.1)

Workers successfully processed the payloads for the mission, including the SPACEHAB Logistics Single Module, and an



Inside the Space Station Processing Facility high bay, technicians begin to process the European Space Agency's Columbus module.



The S3/S4 truss segment is tilted on a work stand inside the Space Station Processing Facility high bay during processing to prepare the element for delivery to the space station on mission STS-117.

integrated cargo carrier containing the service module debris panels and other deployable payloads. The team successfully processed the P5 truss for the 12A.1 mission, which launched aboard Space Shuttle Discovery in December 2006.

#### Mission STS-117 (13A)

The team completed all processing and flight closeouts for the S3/S4 integrated truss segment in preparation for the start of shuttle integration activities in early 2007. Significant accomplishments included replacing the lower deck batteries due to longer time spent on the ground than expected, removing and replacing the lower deck solar array wing to support battery replacement, rotating the cargo element following battery replacement and other processing activities. The S3/S4 is a mirror image of the P3/P4 integrated truss segment which flew on STS-115.

#### Mission STS-118 (13A.1)

Processing of the External Stowage Platform-3 included work on a nitrogen tank assembly, a battery charge/discharge unit and a Canadian pitch/roll joint. In October 2006, KSC supported an assessment to add a spare control moment gyroscope to replace a failed gyroscope during the mission. The mission processing team also verified the P5 truss segment for delivery on this mission.

## FUTURE STATION ELEMENTS

### Node 2 “Harmony” module

Node 2 is the building block that will connect the U.S. Lab Destiny, the Japan Aerospace Exploration Agency’s “Kibo” ex-

periment module and the European Space Agency’s Columbus research module to the station. Accomplishments for NASA’s Node 2 include continued flight internal closeouts, water circulation activities and reinstallation of the modified aft hatch from Marshall Space Flight Center in Huntsville, Ala. Resupply and return racks were installed, preliminary closeouts continued on the active common berthing mechanism and final power-up testing of the Node was completed. The Node 2 module is scheduled for delivery to the station on mission STS-120, currently scheduled for launch in late 2007.

### Columbus module

The European Space Agency’s Columbus research module arrived at KSC in May 2006. Processing highlights since that time include an element leak test in the Operations and Checkout Building vacuum chamber and supporting the ESA in module processing. With its four internal payload racks and two external accommodations for payloads, the laboratory will significantly increase the station’s research capability. The Columbus module will be delivered to the station on mission STS-122, currently scheduled for launch in late 2007.

### JAXA Missions (1J, 1J/A, 2J/A)

The Japan Aerospace Exploration Agency, or JAXA, and its contractors continued launch site preparations of the pressurized module “Kibo” for its upcoming flight on the 1J mission in early 2008. In October 2006, an “end-to-end” test was performed involving the transmission of commands from the JAXA space station control center at the Tsukuba Space Center in Japan to the module at KSC, and return of telemetry from the module to Tsukuba. The test served to successfully validate flight hard-



An overhead crane moves the P3/P4 truss segment across the floor to the waiting payload canister inside the Space Station Processing Facility. The truss was delivered to the space station on mission STS-115.

ware, the control system and procedures. JAXA's Experiment Logistics Module Pressurized Section arrived at KSC in March 2007. The module will be launched on mission STS-123 in early 2008.

#### Canada's Dextre robotic manipulator

The Canadian Special Purpose Dexterous Manipulator, or "Dextre," will fly on a Spacelab-era pallet on mission STS-123. In the Space Station Processing Facility high bay, technicians are currently reconfiguring the flight support equipment installed on the pallet from an earlier mission. Dextre arrived at KSC in June 2007.

#### S6 truss segment

The last truss segment to fly, the S6 will be the final addition to the space station's power and support structure. The S6 arrived at KSC in December 2002, and the KSC team has been working diligently since then to ensure the vehicle is ready for launch. Future processing work includes battery replacement, installation of one of the solar array wings and around-the-clock testing of the vehicle's batteries and coolant systems. The S6 truss is scheduled to be delivered to the station on mission STS-119 no earlier than mid-2008.

#### Cupola

The Cupola is currently in the Space Station Processing Facility intermediate bay awaiting launch. When delivered to the space station, the Cupola will provide astronauts a window to the universe, as well as to the station. After the Node 3 module arrives from Italy, the Cupola will be joined to the Node for launch in 2010.

#### Operations and Checkout Building

The Operations and Checkout Building experienced many changes during 2006. In the high bay, personnel removed the old test stands used during Spacelab-era processing. Also, the team reactivated the west end doors after 25 years of non-use, symbolically opening the doors for exploration. Lockheed Martin plans to spend the next couple of years outfitting the building's high bay in preparation for final assembly of NASA's new Orion spacecraft.

> The Delta II rocket stands ready for fueling in preparation for launch on Space Launch Complex 2 at Vandenberg Air Force Base in California. The launch vehicle, carrying NASA's CALIPSO and CloudSat satellites, launched at 6:02 a.m. on April 23, 2006.



ORION



NASA



CALIPSO  
CLOUDSAT

ORION



# Launch Services Program

NASA's Launch Services Program was busy processing expendable launch vehicles and spacecraft for three successful launches and planning for future launch capability.

In 2006, the Launch Services Program conducted a study to assess the value and risks associated with current launch systems

relative to the potential value and risks associated with new launch systems emerging in the commercial market. The results of the study provided the agency with appropriate information to make important decisions to sustain an effective and efficient space launch program for NASA spacecraft well into the next decade.

The program also continued supporting the Vision for Space Exploration by providing expendable launch vehicle expertise, information and guidance for ground operations and requirements development for the Crew Launch Vehicle (Ares I) and the Cargo Launch Vehicle (Ares V).

## New Horizons

NASA's New Horizons spacecraft launched aboard a Lockheed Martin Atlas V vehicle on Jan. 19, 2006, from Cape Canaveral Air Force Station. New Horizons is the first mission to the dwarf planet Pluto and the Kuiper Belt. New Horizons will fly by Pluto and its moon, Charon, as early as 2015, then head deeper into the Kuiper Belt in a potentially extended mission to examine one or two of the ancient, icy objects in that vast region more than a billion miles beyond Neptune's orbit. This mission intends to provide an incredible story about the origin and evolution of the planets. For more information on the New Horizons mission, visit [www.nasa.gov/mission\\_pages/newhorizons/main/index.html](http://www.nasa.gov/mission_pages/newhorizons/main/index.html).

The team worked through several processing obstacles, including supporting a compressed approval process, hurricane damage to hardware and a facility, and failure of a fuel tank during qualification testing. They also completed the challenge of processing a nuclear-powered payload during the holiday season, coordinating a multi-contractor integration and launch team, and meeting a tight planetary window.

## Space Technology 5

The Space Technology 5 spacecraft, also known as ST5, launched on an Orbital Sciences Corporation Pegasus XL expendable launch vehicle on March 22, 2006, from Vandenberg Air Force Base.

The Launch Services Program team worked closely with the launch vehicle team and the spacecraft customer to ensure the safe operation of a unique spacecraft release system that will support future micro-satellites.

The ST5 spacecraft is part of the agency's New Millennium Program and consisted of three miniature spacecraft called micro-sats that weigh only 25 kilograms each, but have capabilities

NASA's New Horizons spacecraft roared into the blue sky aboard an Atlas V rocket, spewing flames and smoke, on Jan. 19, 2006. New Horizons was the fastest spacecraft ever launched, reaching lunar orbit distance in just nine hours and passing Jupiter 13 months later.



ties comparable to those of much larger spacecraft. ST5 served as a pathfinder for future science missions by demonstrating the benefits of a constellation of small, low-cost spacecraft obtaining simultaneous measurements in different locations. After completing a 90-day mission, the mission team shut down the spacecraft in June 2006. For more information on the ST-5 spacecraft, visit [www.nasa.gov/mission\\_pages/st-5/main/index.html](http://www.nasa.gov/mission_pages/st-5/main/index.html).

#### CALIPSO / CloudSat

CALIPSO and CloudSat were co-manifested on a Boeing Delta II launch vehicle that lifted off on April 28, 2006, from Vandenberg Air Force Base. The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations satellite, or CALIPSO, was developed to help scientists answer significant questions and provide new information about the effects of clouds and aerosols (airborne particles) on changes in the Earth's climate. This information will lead to more accurate climate model predictions and provide international and national leaders with reliable information to make more informed policy decisions about global climate change.

To ensure the success of the mission, the Launch Services Pro-

gram team overcame launch delays associated with flight hardware qualification and several other technical issues. The team also worked with the Glenn Research Center in Cleveland to perform a modal survey test to help determine the cause and appropriate corrective actions associated with broken welds on the launch vehicle main engine. The underlying challenge was in managing the expectations of spacecraft customers as these issues were resolved. For more information on the CALIPSO/CloudSat mission, visit [www.nasa.gov/mission\\_pages/cloudsat/launch/launch-index.html](http://www.nasa.gov/mission_pages/cloudsat/launch/launch-index.html).



(above) The Orbital Sciences L-1011 jet aircraft releases the Pegasus XL launch vehicle carrying the Space Technology 5 spacecraft with its trio of micro-satellites from Vandenberg Air Force Base, Calif., on March 22, 2006.

The CALIPSO spacecraft was processed inside the Astrotech Payload Processing Facility on Vandenberg Air Force Base in California. The CALIPSO and CloudSat satellites were launched aboard a Delta II vehicle on April 28, 2006.

The orbiter Discovery touches down on Runway 15 at NASA's Shuttle Landing Facility on July 17, 2006, completing mission STS-121 to the International Space Station.





United States



# Constellation Ground Operations

Kennedy Space Center's Constellation Ground Operations project office continued to support early Constellation Program development efforts during the fiscal year. Progress was made in a variety of areas, including development of ground systems and requirements, design support for the Crew Exploration Vehicle, Crew Launch Vehicle and Lunar Lander, and planning for integrated launch operations.

A significant milestone in the Constellation Program will be a test launch of the Ares I-X Crew Launch Vehicle from the center in 2009. During the past year, countdown models and command, control and data management concepts were developed for launch operations. Following NASA's decision to launch a Hubble Space Telescope servicing mission, options to modify Launch Complex 39B were assessed to accommodate shuttle launch-on-need requirements, as well as the Ares I-X launch.

During the past year, detailed concepts for ground systems and facility systems were developed for Constellation missions

to the International Space Station, as well as for lunar missions planned for late in the next decade. KSC awarded 90-day studies through a broad agency announcement to elicit additional innovative approaches from industry for infrastructure development and ground processing. The study results were used to refine in-house concepts and planning.

Launch Equipment Test Facility contracts were awarded for sandblasting and painting to support eventual ground systems testing. Historic Firing Room 1 in the Launch Control Center was transferred to the Constellation Program. Equipment used for more than 20 years by the Space Shuttle Program was removed in preparation for the installation of command and control systems that will be used for the Ares I-X test flight.

In preparation for the Constellation Program Systems Requirements Review, KSC personnel assisted in developing the Constellation Architecture Requirements Document, the Operations Concept document and Ground Systems to Crew Exploration Vehicle and Crew Launch Vehicle interface requirements documents. KSC co-led the Ground and Mission Operations System Integration Group and participated in several other integration groups to develop many of the Constellation architecture requirements. The center began work on other requirements documents, including the Level 3 Ground Systems, and Level 4 Mobile Launcher, Launch Pad and Command and Control documents.

In addition to modifying and developing new facilities and systems at the launch site, KSC personnel are also involved in the early design and development of the Crew Exploration Vehicle (Orion) and the Ares I Crew Launch Vehicle. The Constellation Program is using KSC's extensive experience in ground operations to infuse operability into the early design of the flight hardware elements, in order to reduce overall operation costs. The Ground Operations Project Office was involved in planning for several key areas, including avionics, propellant servicing, ordnance and pyrotechnics, and Crew Exploration Vehicle landing and recovery.

< A concept image shows the Ares I Crew Launch Vehicle on the launch pad at Kennedy Space Center.

> A concept image shows the Ares I Crew Launch Vehicle during ascent. Ares I is an in-line, two-stage rocket configuration topped by the Orion Crew Exploration Vehicle and launch abort system. Ares I will carry the Orion with its crew of up to six astronauts to Earth orbit.





# Applied Technology



Inside the Space Life Sciences Lab, workers prepared the Passive Observatories for Experimental Microbial Systems, also called POEMS, for mission STS-121.

KSC's technology experts are enhancing current programs, preparing for missions to the moon, developing weather forecasting tools and more to support the center's leadership role in technology.

Some of KSC's technology projects ensure safe space shuttle operations. For example, workers demonstrated a new inspection system on orbiter windows, which greatly improved the resolution of observed defects that can weaken the windows and potentially lead to cracks.

The center is also home to NASA's invention of the year and commercial invention of the year—the emulsified zero-valent iron environmental remediation technology. This technology improves the method for purifying in soil, such as areas around abandoned launch pads.

Workers also developed an LED lighting module to test the benefits of the rugged, reliable, lower-power technology to replace older technologies and provide new options for Constellation vehicles. NASA is planning to test this module on the International Space Station, as well.

Understanding bacteria growth characteristics in zero gravity plays an important role in long-term space travel. To evaluate zero gravity's effect on microbe growth, a microbial growth experiment – Passive Observatories for Experimental Microbial Systems – flew on the space shuttle and space station.

NASA is developing ways to reduce costs and configure launch schedules in a timely manner, by investigating options that would eliminate the need for down-range tracking assets. Workers used sounding rocket and aircraft flights to test the use of communication relay satellites, such as the Tracking and Data Relay Satellite and the global positioning systems, as an alternative to ground-based tracking. The performance of the systems is very encouraging.

Technology experts are battling the natural elements that interfere with spaceport projects, as well. The center's corrosion lab established the National Corrosion Technology Alliance, with membership spanning the U.S. Department of Defense and various industries. This consortium serves as a “one-stop shop” for corrosion information and solutions. Furthermore, the electrostatics lab developed a filter to keep KSC's gaseous nitrogen lines and critical parts free of contamination.

Workers can now forecast the threatening anvil clouds a thunderstorm brings to spaceflight operations much earlier because of the “anvil threat corridor forecast tool,” developed by the Applied Meteorology Unit, which is managed by the KSC Weather Office. By gaining up to three hours of advance notice, forecasters at the U.S. Air Force 45th Weather Squadron at Cape Canaveral Air Force Station are using the tool to support space shuttle operations, as well as NASA, Department of Defense and commercial expendable vehicle launches. The National Weather Service Spaceflight Meteorology Group at Johnson Space Center is using the tool to support space shuttle landings.

KSC's technology is also paving the way for future moon missions. To support JSC's lunar architecture team in predicting the cratering effects of lunar-landing vehicles, KSC experts provided analysis of the effects of a specific thruster configuration that is under consideration. The KSC in-situ resource utilization team is leading the efforts for an oxygen production demonstration to explore technology that creates oxygen and other needed materials from lunar regolith, loose material on the moon's foundation. Dust accumulation could degrade the performance of solar panels on the moon. The electrostatics lab demonstrated methods for using electric fields to remove performance-hindering dust from solar panels on the moon, spacesuit joints and other moving parts. KSC also supported a lunar lander study by providing a lander concept, expert landing and launch concepts, umbilicals for transferring cryogenic consumables on the lunar surface, an innovative lander airbag design, advanced densified propellant concepts and a cargo handling system concept.

When working with launch vehicles or aircraft, a problem with one tiny wire could paralyze performance. However, KSC's “standing wave reflectometer” can accurately pinpoint malfunctions within cables and wires to reliably verify conditions of electric power and signal distribution. A commercial firm is marketing products based on this technology. The U.S. Army includes these instruments in the helicopter battle damage and repair kits that go to Afghanistan, Iraq and other parts of the world where helicopter support is required.

# Partnerships

Kennedy Space Center continued to strengthen partnerships with Space Florida (the state's aerospace development organization), space-related industry leaders, state and local economic development entities, elected officials and community leaders to accomplish agency and center goals. Key partners included the Florida Governor's Office and the Governor's Office of Trade Tourism and Economic Development, Space Florida, the Economic Development Commission of Florida's Space Coast, the Metro Orlando Economic Development Commission, Enterprise Florida Inc., the Florida High Tech Corridor Council, the Florida Legislature, the Florida Congressional Delegation, elected officials, chambers of commerce and various key civic associations local to KSC.

A major accomplishment facilitated by KSC's partners was a successful initiative aimed at bringing up to 300 to 400 high-tech jobs to the center in association with final assembly and testing of the Crew Exploration Vehicle. This effort alone resulted in \$35 million of state funds being set aside for a commercial entity performing NASA-related work at KSC. Similar partner efforts are under way to attract Commercial Orbital Transportation Systems launch operations and to showcase Central Florida's high-tech capabilities.

Throughout the year, the center hosted members of Congress, state legislators, local elected officials and congressional and state legislative staff members who were on hand to learn about KSC and view expendable vehicle and space shuttle launches. KSC supported extensive activities to maintain and enhance legislative relationships with local, state and federal elected officials. Briefings were given to 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 staff, along with the NASA administrator, participated in events marking the annual Florida Space Day in Tallahassee. KSC also supported NASA's Office of Legislative and Intergovernmental Affairs in the annual "Days on the Hill" in Washington, D.C.

KSC's partnerships with charitable organizations in Brevard County, principally United Way of Brevard, served as a vehicle for employees to contribute to the healthy and growing local community, as well as numerous charities across the nation. In keeping with this year's theme, "Caring and Sharing - Combined We Make a Difference," KSC employees voluntarily contributed more than \$415,000 in donations through the 2006 Combined Federal Campaign.



Florida Rep. Thad Altman, at left, and then-Attorney General Charlie Crist tour Kennedy Space Center in June 2006. They stand beneath one of the main engines of Space Shuttle Discovery, perched for launch on mission STS-121.

# Environmental Leadership

The Kennedy Space Center protects and preserves its rich natural and cultural resources as it pursues the goal of safely completing space shuttle missions and constructing the International Space Station.

KSC's recycling program includes materials from operational and administrative processes and includes materials such as scrap metal, paper and cardboard, copier toner cartridges and concrete. The funding for these efforts is generated by recycling revenues, which totaled more than \$237,000 during the fiscal year. This represents the center's total recycling of more than 36 million pounds of materials that were diverted from disposal and recycled for useful purposes. A major focus of the KSC recycling program is to recycle waste concrete generated by center demolition activities. Throughout fiscal year 2006, KSC conducted a successful concrete recycling pilot project that reused about 950 tons of crushed concrete for a new parking lot at the Utility Shop. Use of this recycled concrete resulted in significant cost savings and diverted a significant volume of solid waste from landfill disposal.

KSC also partners with state and federal regulatory agencies. One successful example is the Florida Department of Environmental Protection's approval for an alternate management process for inorganic zinc paint wastes. Due to KSC's unique environment and operations, the center occasionally manages significant amounts of these paint wastes. The federal and state waste regulations require these wastes to be completely contained during storage and transportation. However,



Environmental specialists from Dynamac and the U.S. Fish and Wildlife Service worked together to free a nesting green turtle from under some debris on the beach at KSC.

due to the chemical composition of the inorganic zinc paint, complete containment can cause gases to build up, resulting in safety concerns. The new process prevents this by allowing the paint to dry before containerization.

KSC led a NASA-wide effort to develop criteria to consistently identify and address historic resources associated with the Space Shuttle Program. This will help to ensure that unique historical aspects and properties of the shuttle program are adequately preserved for posterity as NASA moves into future spaceflight activities.



< Alligators sun themselves on the bank of a pond.

> A mother osprey, left, sits protectively next to one of her chicks in her nest. Behind the nest can be seen the immense flag painted on the side of the Vehicle Assembly Building.



# Education

Kennedy Space Center's Education Programs and University Research Division offered innovative learning opportunities to educators and students.

## K-12 Programs

Operated by the University of Central Florida and the Florida Space Grant Consortium, the NASA Education Exploration Team provides science, technology, engineering and mathematics-related professional development workshops for educators, hands-on classroom activities for students and educational information to the general public. The team held workshops with more than 3,000 teachers, almost 18,000 students and 9,000 others in the general public. The team also partnered with Delaware North and Brevard County schools during Space Week, which welcomed Brevard's sixth-graders to the center.

In 2006, the NASA Explorer Schools Program, which focuses on fourth- through ninth-grade educators and students, added three new teams from Georgia and the Virgin Islands to KSC's 15 existing teams. KSC provided professional development for teachers in the program, and Explorer Schools once again enjoyed a year filled with outstanding achievements. Addition-

ally, hundreds of students from at least 13 schools in the KSC and Langley Research Center regions attended space shuttle launches and launch attempts at KSC.

For the fourth year, KSC and the University of Central Florida co-hosted the 2006 Florida for Inspiration and Recognition of Science and Technology (FIRST) Robotics Regional Competition. KSC sponsored the Pink Team from Rockledge and Cocoa Beach High Schools and the Bionic Tigers from Cocoa High School.

In conjunction with the New Horizons launch on Jan. 19, 2006, a national education conference was held at KSC and in nearby Cocoa Beach for teachers. Educators experienced the mission and learned about other NASA missions from the scientists, engineers and students involved. It was sponsored by NASA, the Johns Hopkins University Applied Physics Laboratory, the Southwest Research Institute and KSC. The materials help educators enhance classroom teaching of science, technology, engineering and mathematics. The Exploration Station staff also conducted a program focusing on the New Horizons mission's science for 45 high school students.

## Higher-Education Programs

NASA's Exploration Systems Mission Directorate partnered with the National Space Grant Consortium to initiate a new higher-education student program for which KSC provides the overall agency program management. Hundreds of students are involved in this program, which consists of three student opportunities: exploration-related internships, engineering design challenge teams and senior design projects.

The Graduate Student Research Program awarded 14 fellowships for graduate study leading to master's or doctoral degrees in the fields of science, mathematics and engineering related to NASA research and development.

## Minority-Focused Programs

Kennedy Space Center participated in the annual observance of National Disability Employment Awareness Month by co-hosting a Disability Mentoring Day with the Disability Awareness and Action Working Group at the center. Mentors and 27 students were matched based on career interests and spent the day together.

KSC hosted 17 pre-service teachers selected to participate in the Pre-Service Teacher Institute. This program provides minority pre-service teachers and faculty members with opportunities to enhance their knowledge and skills in teaching mathematics and science, and shows them how to access NASA educator resources.

## Informal Education

The STS-121 Return to Flight DVD was a NASA Explorer Institute partnership between KSC's Education Office and the Denver Museum of Nature and Science. It provided the pub-



At Warrington Middle School in Pensacola, Fla., astronaut Alan Poindexter talks to students. Poindexter joined past Center Director Jim Kennedy on a visit to the school, which has been named one of NASA's Explorer Schools.



Members of the “Pink Team” explain their robot to former Florida Gov. Jeb Bush at the 2006 FIRST Robotics Regional Competition held March 9-11 at the University of Central Florida in Orlando. The Pink Team, whose robot is named Rocrobot, is co-sponsored by NASA KSC.

lic with a glimpse of the inner workings of the return-to-flight efforts. The DVD profiled many people involved in the effort, including NASA Shuttle Program Manager Wayne Hale, STS-121 crew member Stephanie Wilson and STS-114 crew member Steve Robinson. The DVD was distributed to museums, science centers, planetariums and schools nationwide.

Thirty-seven Boy Scouts and 140 Girl Scouts leaders and volunteers from Central Florida completed the “train-the-trainer” workshop provided by the KSC Educator Resource Center staff. The staff also provided educational workshops to 529 Central Florida home-schooled students.

### Electronic Education Projects

KSC’s Virtual Lab, a software simulation of four high-end microscopes, recently received a NASA software award. A Space Act Agreement is being developed with Microsoft to incorporate the lab into one of the company’s new educational projects. The software can be downloaded from <http://virtual.itg.uiuc.edu>.

Students act as system engineers and address launch problems related to their studies via the Kennedy Launch Academy Simulation System, an interactive software program for schools that simulates a space shuttle launch countdown. The program has been tested at two schools with a high degree of success and parent involvement.

KSC’s Digital Learning Network, or DLN, connected NASA scientists, engineers and education specialists with teachers and students of Explorer Schools through interactive videoconferencing. The DLN interacted with other schools and informal educational institutions in 28 states. The DLN delivered educational modules, mock press conferences, community programs, family nights, and special events such as a panel of scientists explaining the New Horizons, STEREO and THEMIS expendable vehicle launches.

KSC’s DLN also hosted the Student Dust Counter news conference on Jan. 17, 2006, as part of the New Horizons mission. The Student Dust Counter is the first student-built instrument selected by NASA to fly on a planetary mission. Students from across the country were able to question the Dust Counter student designers to see what it’s like to build a spacecraft. Built by students at the University of Colorado at Boulder, the counter will monitor the density of dust grains in space. Researchers consider dust grains the building blocks of the solar system’s planets. The team hopes to identify as-yet-undetected clumps of dust in the dust disk of the solar system caused by the gravity of the outer planets.

During a visit to the center, students participate in Exploration Station activities, which offer hands-on learning experiences.



# Outreach to the World

## KSC Visitor Complex

The Kennedy Space Center Visitor Complex effectively spread NASA's message to more than 1.4 million guests from all over the world. This number should grow in 2007 with the opening of the "Shuttle Launch Experience." In 2006, significant progress was made in developing the new attraction, which immerses guests in the sights, sounds, feelings and excitement of a vertical launch in mankind's most complex vehicle. Because launch viewings draw enthusiastic tourists and residents from the Central Florida marketplace to the center, the Visitor Complex hosted thousands of guests for the two NASA space shuttle missions and one expendable launch vehicle mission launched from KSC during the fiscal year.

Another significant investment was improving the Visitor Complex's guest experience by refurbishing the complex's central plaza to improve the flow of foot traffic, weather protection and the sense of arrival for guests. The bus boarding loop's safety and loading efficiency was improved, and a conceptual design to introduce the public to NASA's Constellation Program was created. Other elements of the complex's 10-year master development plan are under way and continuously being refined.

The Orlando International Airport retail stores thrive while providing exposure to NASA and offering space-related products to more than 25 million travelers commuting through one of the top-10 busiest airports in the country. Additionally, shore excursions to the Visitor Complex from cruise ships arriving at Port Canaveral remain popular.

Overall, the complex's educational programs reached 78,000 students in 2006 and achieved a 15-percent increase in

Camp KSC, 27-percent increase in Overnight Adventures and 6-percent increase in Astronaut Training Experience participation. These programs contribute to NASA's mission to inspire the next generation of explorers. The complex hosted more than 10,000 sixth- and seventh-grade Brevard County students through Brevard Space Week and Brevard Learning About Science and Technology programs in partnership with the Brevard County School Board, NASA Education and the National Space Club's Florida chapter.

Furthermore, special events included the induction of the fourth class of space shuttle astronauts to the U.S. Astronaut Hall of Fame, the 25th anniversary of STS-1, and the Gemini XII 40th anniversary.

## Guest Operations

KSC's Guest Operations staff enabled more than 11,000 NASA guests to participate in behind-the-scenes KSC tours, including lessons provided by center engineers and operational experts. Additionally, KSC hosted thousands of the agency's invited guests to participate in briefings and view launches on NASA's five missions. These guests included members of Congress, business and agency leaders, astronaut families, medical and legal professionals, veterans, teachers, students and the general public.

Nearly 45,000 employees and family members celebrated and participated in the return of the annual Family Day event, which provided workers an opportunity to share their workplace with family and friends. This tradition had not occurred since 2000 due to security concerns following the Sept. 11 terrorist incident.



## Exhibits

KSC's Display Management Team and Kennedy Integrated Display Staff supported 27 events, mostly in the southeast region of the country, reaching out to nearly 625,000 visitors individually. KSC's road show, displays and handouts explained NASA's exciting spaceflight history, education, science and technology programs and focused on the Vision for Space Exploration and spin-offs. Participation included minority events, air shows, technical and educational conferences, and trade shows.

## Speakers Bureau

KSC's Speakers Bureau reached more than 69,000 people at 224 events, including four inter-

During a visit to Kennedy Space Center, Vice President Dick Cheney (second from right) and his family view Atlantis in the Orbiter Processing Facility. To his right is Shana Dale, NASA deputy administrator.



NASA Test Director Ted Mosteller, right, briefs the media about Firing Room 4, which underwent a two-year renovation to add sound-suppressing walls and floors, humidity control, fire-suppression systems and consoles, and more. It is now designated the primary firing room for all remaining space shuttle launches, and will also be used daily to manage operations in the Orbiter Processing Facilities.

national and 26 national events. Diverse KSC speakers, NASA astronauts and the Visitor Complex “Spaceman” were deployed for some events. KSC brought the NASA message to educators, scientists, government representatives, special interest groups, industry officials and others throughout the world, reaching minority groups including Hispanic, Asian-American and African-American organizations.

### KSC Web site and NASA Direct

Kennedy’s Web site is the front door to the center’s programs and one element of NASA’s expansive Web presence. Kennedy’s Web operations team was busy tracking the processing and launching of five missions and airing five live launch webcasts, including the New Horizons launch to the edge of the solar system. Most importantly, by the end of 2006, users’ satisfaction with the portal reached its highest sustained level ever, and people visited [www.nasa.gov](http://www.nasa.gov) 106.6 million times, 25 percent more than in 2005.

By transitioning into a multimedia studio, the Web studio began producing additional non-traditional formats and expanded its audience outside of the Internet. Kicking off with the New Horizons mission, podcasts became a regular part of operations products, and now all KSC launches are available for download to personal computers or mp3/mp4 players. The “Ask the Astronaut” podcast, at [www.nasa.gov/astro-nauts/astro-nauts\\_mm\\_collection\\_archive\\_1.html](http://www.nasa.gov/astro-nauts/astro-nauts_mm_collection_archive_1.html), remains one of NASA’s top 10 podcasts.

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 partnership with HDNet to broadcast all NASA launches in high-definition TV on the HDNet network; a Web operation which includes live webcasts, television streams and on-demand video; and a full-service Public Affairs Office catering to all forms of professional journalists.

The highly popular live launch blog brings Web visitors along on NASA’s exciting countdown to launch with up-to-the-minute updates and video highlights. Interesting feature stories, stunning photo galleries and interactive multimedia programs round out the experience.

### 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 broadcasting all NASA launches; a 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 150,000 multimedia products were produced, including fact sheets, press releases, video news releases, live and radio phone-in interviews, still photographs, video footage, tapes, CDs and DVDs.

# 2006 KSC Business Report

Fiscal year 2006 was a successful year in terms of the center's budget stability, progress toward KSC's new roles and responsibilities, and continual improvements in the center's financial systems. While the overall KSC budget decreased slightly from FY 2005 levels, the major programs were largely unaffected. A budget increase for the Constellation Program has firmly established the program as the next major mission for the center as the Space Shuttle Program phases out at the end of the decade. Successfully executing the KSC program not only supported the agency's mission, but served as a major economic driver for the state and local economy.

KSC's financial systems and processes continue to evolve and improve, with two system improvements initiated during the fiscal year, in parallel with readying a major system upgrade and new modules for implementation in 2007 and beyond. Business processes also were modified due to a redesigned budget process and the opening of a centralized center for business services.

As NASA continues to seek a clean financial opinion from independent auditors, KSC is supporting this effort by partici-

pating in regular agency audits and developing and applying internal controls to all financial activities. KSC made major contributions to the elimination of two agency material weaknesses (reconciled funds balance with the U.S. Treasury and unfunded environmental liability). Under agency direction, KSC is developing improvements in the valuation of NASA's Property, Plant and Equipment and implementing improvements in financial management systems and data integrity to enable NASA to meet its target of a clean financial opinion.

## FINANCIAL HIGHLIGHTS

More than \$2 billion of work was budgeted at KSC in FY 2006, which includes all space shuttle work performed under the Johnson Space Center's Space Flight Operations Contract (SFOC), as well as other NASA centers' activities. KSC managed \$1.6 billion of this budget and received \$236 million in reimbursable work from 117 active agreements with non-NASA entities.

## PROGRAM BUDGET HIGHLIGHTS:

- In FY 2006, the Space Shuttle Program executed its \$900+ million budget accomplishing two successful missions (STS-121 with Discovery in July and STS-115 with Atlantis in September) and preparing for four flights scheduled in FY 2007.
- The FY 2006 Launch Services Program budget supported the successful launch of three missions (New Horizons, ST-5 and CALIPSO/CloudSat) and preparations for seven missions manifested in FY 2007.
- International Space Station funding maintained an inflationary increase in its FY 2006 funding level in a year which marked the delivery of a major structure (the P3/P4 truss segment and associated solar arrays) to the space station.
- The Exploration activity doubled its budget in FY 2006 over the previous year to \$126 million, with \$100 million of the total allocated to the newly established Constellation Program. With the program's selection of a prime contractor to design, develop and build the Orion Crew Exploration Vehicle, and projected budget increases over the next few years, the KSC transformation is well under way.

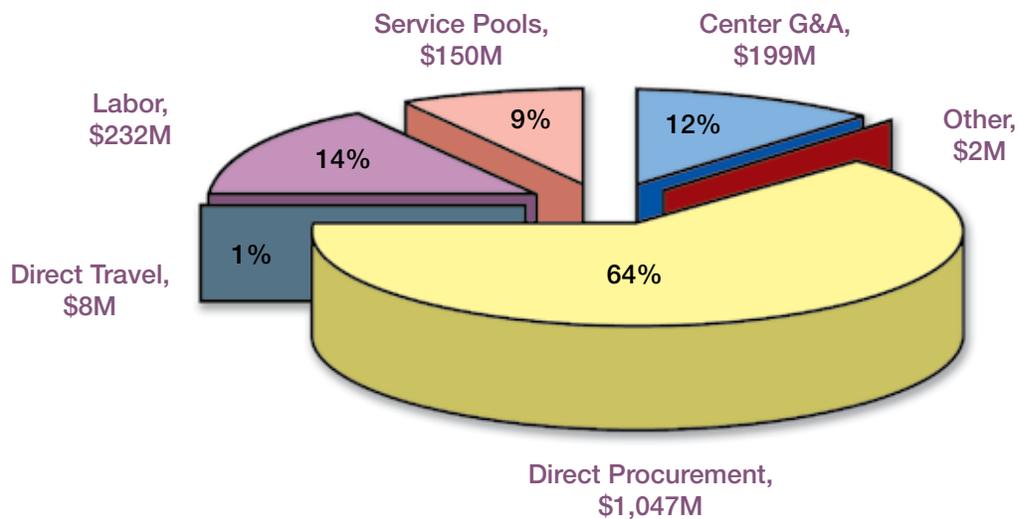


## KENNEDY SPACE CENTER FY 2006 BUDGET AUTHORITY (\$ Millions)

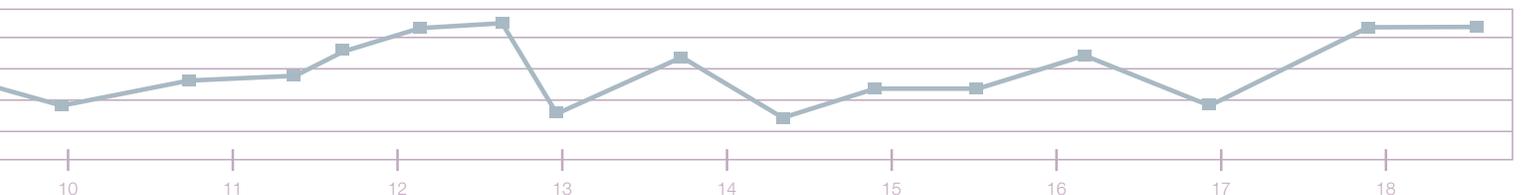
Space Shuttle	\$437
SFOC	\$524
International Space Station	\$141
Launch Services	\$330
Constellation	\$126
Other	\$80
<b>Total KSC</b>	<b>\$1,638</b>

This FY 2006 budget authority is expressed in "full-cost" terms, as each project budget includes required KSC services and the appropriate level of center overhead charts. SFOC work is included.

### FY 2006 KSC Budget by Element



This chart depicts the KSC budget elements which are included within each project budget for FY 2006. In FY 2007, Center G&A and Service Pools have been combined into a Center Management and Operations account, separate from project budgets. The total budget of \$1.638 billion includes SFOC work.



## FINANCIAL SYSTEMS

Continued progress has been made at KSC and across the agency to transition to a single financial information system under the Integrated Enterprise Management Program. FY 2006 saw the successful implementation and smooth transition of two new modules: the Program Management Information Initiative and the Agency Labor Distribution System.

Much of FY 2006 was spent readying three new modules and upgrades for implementation in FY 2007-2008.

The SAP Version Update is an upgrade to the current SAP-developed core financial system, which should enhance and improve the processes and functionality of the current system.

The Contract Management Module, an initiative led by KSC's Procurement Office, provides a new tool to support contract writing, contract administration, procurement workload management and data reporting to facilitate and expedite the NASA procurement processes.

eTravel, one of the five e-Gov initiatives launched in response to the President's Management Agenda, is a commercially hosted travel system that will provide end-to-end online travel services which will function similar to Orbitz or Travelocity. It is scheduled for implementation in 2008.

## BUSINESS PROCESSES

Just as new systems drive changes in business processes, new leadership does, as well. FY 2006 saw major changes to budget formulation and execution across the agency. An old process became new again as Program Planning and Budget Execution was instituted during the budget-development process. This is a methodology for aligning resources in a comprehen-

sive, disciplined, top-down approach that supports the agency's vision and mission. It imposed a disciplined schedule and promoted communications at all levels, and was deemed highly successful.

The agency applied the many lessons learned from its two years under full-cost budgeting, accounting and management, and greatly simplified its implementation. The philosophy of full-cost – to fully capture the true costs of NASA's programs and projects – remains the same. However, the implementation has changed for several reasons, including operational complexities with the use of new financial systems, the development of unnecessary center competition and the desire for a single agency overhead rate. A newly created Center Management and Operations account encompasses the previous General & Administrative and Service Pool budgets. Full-cost allocation is now made at the agency level for NASA's programs. The full-cost simplification methodology was used in the formulation of the FY 2008 center budget with great success.

A final significant change to business processes in FY 2006 was the opening of the NASA Shared Services Center at the Stennis Space Center in Mississippi. This new NASA organization has allowed KSC and other centers to reduce on-site administrative functions by performing a variety of human resources, procurement and financial functions in a central location, including previous chief financial officer responsibilities for civil service payroll operations and domestic and foreign travel processing. Human resources and procurement tasks transitioned to the NASA Shared Services Center include senior executive service appointments, training support, processing of grants and cooperative agreements, an agency bankcard program and health fairs, among others. More activities are planned to be transitioned during the next couple of years.



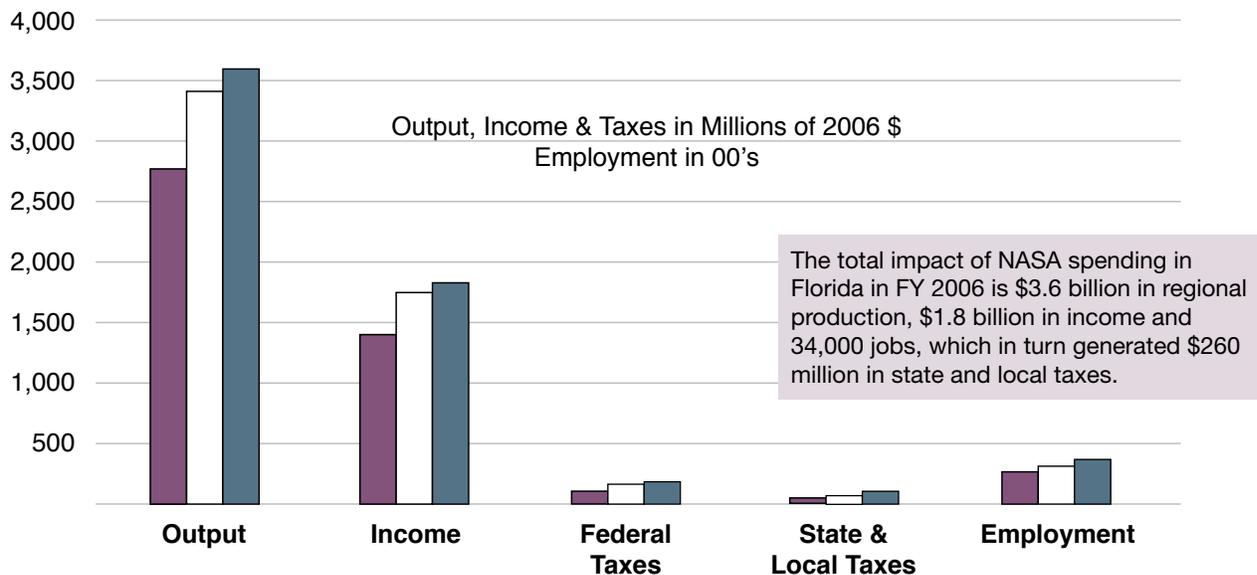
# Economic Impact

To fulfill its mission, NASA and its contractors require an extraordinary range of commodities and services, both technical and non-technical, ranging from expendable launch vehicles, propellants and computers, to pickup trucks, lawn mowers and nuts and bolts. 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 local or regional firms for materials and services. In addition, economic activity is generated through the KSC Visitor Complex and business travel to the region. Each round of such spending recirculates NASA's initial

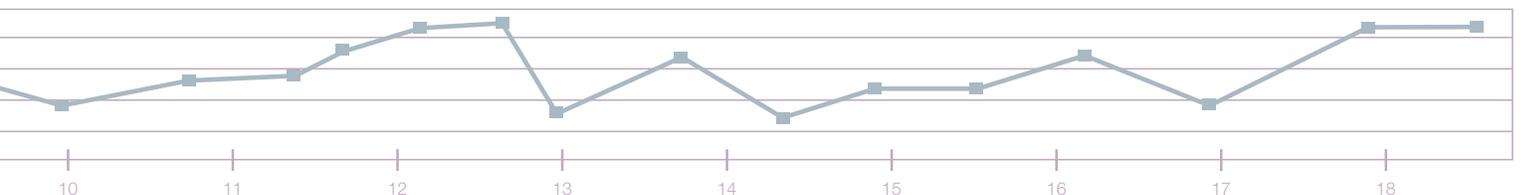
demand among Florida's businesses and households, multiplying the direct impact on the economy.

KSC annually conducts an economic impact analysis to measure NASA's effect on the economy at the local, regional and state levels. The assessment finds that in FY 2006, of the \$16.6 billion NASA budget, KSC and other NASA centers injected nearly \$1.7 billion into the local and state economies of Florida, which induced a total economic impact of \$3.6 billion and 34,000 jobs in the state of Florida. KSC remains by far the major economic driver in Brevard County and a significant contributor to the economic health of the state of Florida.

## The Total Economic Impact of All NASA Activities in Florida FY 2006



Area of Economic Impact	(Millions of 2006 \$)				(Jobs in 00's)
	Output	Income	Federal Taxes	State & Local Taxes	Employment
■ Brevard County	2,787	1,383	121	66	28,400
□ Central Florida Region	3,380	1,704	171	75	32,700
■ State of Florida	3,617	1,768	177	83	34,300



# 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.

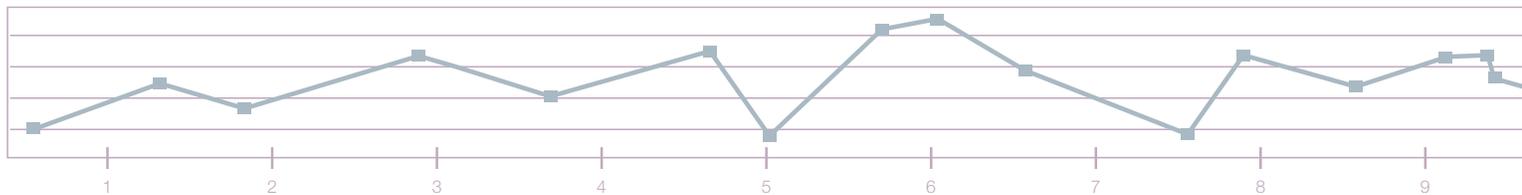
At the end of each year, the center takes a "snapshot" of its work force. This picture includes all federal and contract em-

ployees 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 Sept. 30, 2006, the total KSC population was 14,315. This includes 2,106 full-time and other-than-full-time NASA civil servants and 10,556 total on-site and off-site contractor employees. The civil servant skill mix includes scientific and engineering, administrative, technical and clerical workers. There are 671 construction employees, and 982 tenants on the center.

## KENNEDY SPACE CENTER WORK FORCE PROFILE (through 9/30/06)

<b>Total Civil Servants</b>	<b>2,106</b>
<b>Civil Servant Skill Mix</b>	
Scientific & Engineering	61%
Administration	27%
Technical	7%
Clerical	5%
On-Site Contractor Employees	9,814
Off-Site Contractor Employees	742
<b>Total Contractor Employees</b>	<b>10,556</b>
<b>Total Construction Employees</b>	<b>671</b>
<b>Total Tenants</b>	<b>982</b>
<b>TOTAL KSC POPULATION</b>	<b>14,315</b>



# Procurement Report

## 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 2006. Following is a brief description of their work for the agency:

### 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, grounds and facilities maintenance, custodial service, fire protection, security, calibrations and propellants handling.

### The Boeing Company

Boeing Space Operations Company is the prime contractor for the Checkout, Assembly and Payload Processing Services Contract, also known as the CAPPs Contract. Its primary purpose is to support payload processing for the International Space Station, space shuttle and expendable launch vehicles. Boeing performs all aspects of payload processing, including the planning and receiving of payloads, maintenance of associated payload ground systems, integration of payloads with the space shuttle, launch support and shuttle post-landing payload activities.

### InDyne, Inc.

InDyne, Inc. provides communication services under the KSC Integrated Communications Contract, or KICS Contract, supporting the space shuttle, payload carriers, Launch Services Program and the International Space Station. InDyne provides hardware and software integration and development for voice, video and data communications. InDyne provides motion picture, still photo, digital and video products and services for NASA, commercial expendable launch vehicle and U.S. Department of Defense customers. InDyne also 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 Expendable Launch Vehicle Integrated Support Contract. The contractor is responsible for performing and integrating the overall programmatic business and administrative functions for expendable launch vehicles, or ELVs. This includes program/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, Calif., and engineering services/studies and technical services for various ground/flight ELV systems, missions and payloads. Analex also provides management, operation, maintenance and sustaining engineering of assigned NASA facilities, systems and equipment at Vandenberg.

### The Artic Slope Research Corporation (ASRC) Aerospace

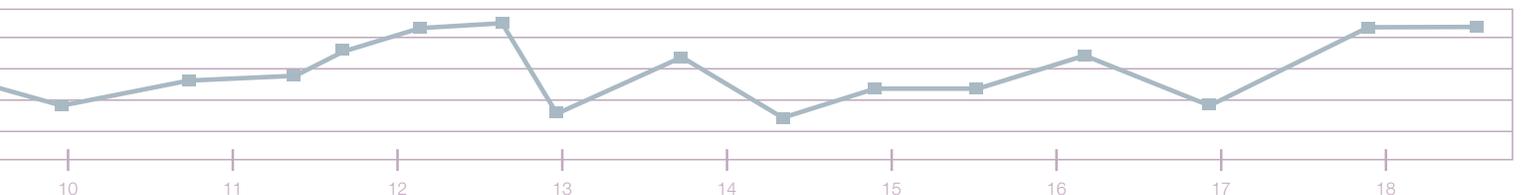
ASRC Aerospace provides research and engineering services and technical support to the KSC Spaceport Engineering and Technology organization and other center operational customers. The support ranges in scope from providing research, engineering development, and management of complex research and development and technology projects, to engineering and technical support of various KSC laboratories and test beds. ASRC Aerospace uses a consortium of affiliated universities in performing applied research and technology development efforts. ASRC Aerospace also provides technology outreach to foster awareness and utilization of KSC's unique capabilities.

### Dynamac Corporation

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

### The Boeing Company

Delta Launch Services, Inc. provides the agency launch services using its Delta launch vehicles. 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 and Vandenberg.



### Lockheed Martin Company

Lockheed Martin Commercial Launch Services, Inc. provides the agency launch services using its Atlas vehicle. Lockheed is the contractor for one of three existing 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.

### OAO Corporation

OAO Corporation, a wholly owned subsidiary of Lockheed Martin Information Technology, performs the Outsourcing Desktop Initiative for the NASA ODIN Contract at KSC. ODIN is an agency initiative to develop a long-term outsourcing arrangement with the commercial sector, transferring the responsibility and risk for providing and managing the vast majority of NASA's desktop, server, and intra-center communication assets and services. ODIN includes hardware and software acquisition, as well as maintenance, mobile devices (such as Blackberries), e-mail, WebEx Internet conferencing, a help desk and other ancillary support services for general purpose workstations for NASA civil servants and on-site contractors.

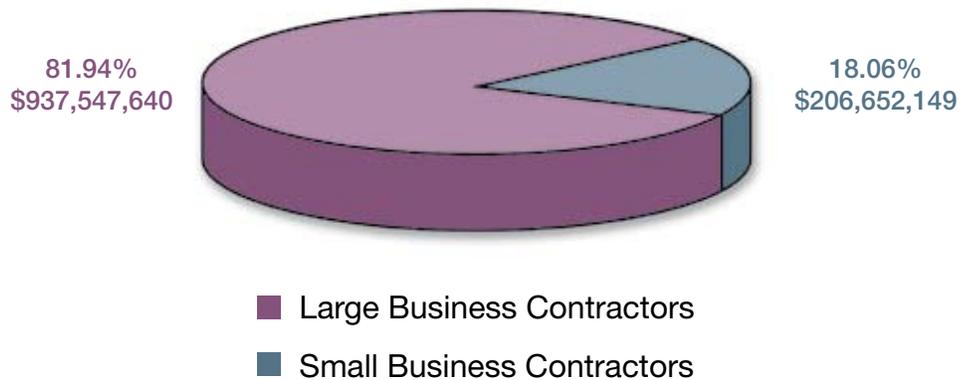
### Orbital Sciences Corporation

Orbital Sciences Corporation, or OSC, provides the agency launch services using its Pegasus and Taurus small expendable launch vehicles which lift off from Cape Canaveral, Vandenberg, Wallops Flight Facility in Virginia, and equatorial launch ranges. OSC is the contractor for one of three existing 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.

### United Space Alliance (USA)

Under a Johnson Space Center contract, USA is the prime contractor for the Space Program 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.

## FY 2006 KSC Dollars Obligated to Large and Small Businesses

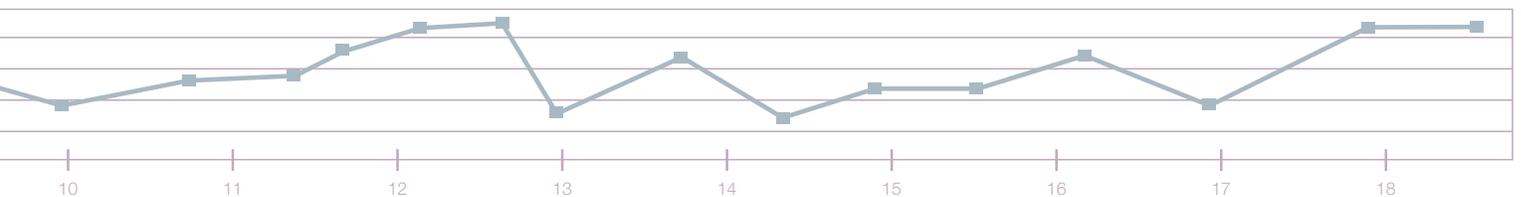


KSC obligated 18.06% of its dollars directly to Small Businesses during FY 2006.



## YOUR PROCUREMENT DOLLARS AT WORK GEOGRAPHICAL DISTRIBUTION BY STATE (FISCAL YEAR 2006 OBLIGATIONS)

State	Total \$	State	Total \$
ALABAMA	482,632	NEBRASKA	4,706
ARIZONA	42,376,157	NEVADA	3,153
CALIFORNIA	5,319,212	NEW HAMPSHIRE	423,824
COLORADO	1,251,869	NEW JERSEY	1,841,367
CONNECTICUT	12,441,630	NEW MEXICO	70,000
DELAWARE	147,219	NEW YORK	555,004
DISTRICT OF COLUMBIA	37,688	NORTH CAROLINA	114,632
FLORIDA	1,044,699,884	OHIO	2,871,107
GEORGIA	709,883	OKLAHOMA	1,162,635
IDAHO	8,566	OREGON	196,366
ILLINOIS	197,679	PENNSYLVANIA	1,427,450
INDIANA	489,923	RHODE ISLAND	521,456
IOWA	15,944	SOUTH CAROLINA	556,010
KANSAS	425,236	SOUTH DAKOTA	10,885
KENTUCKY	208,529	TENNESSEE	434,748
LOUISIANA	14,531	TEXAS	2,056,554
MARYLAND	2,347,409	UTAH	154,845
MASSACHUSETTS	3,343,515	VIRGINIA	4,688,795
MICHIGAN	638,189	WASHINGTON	23,217
MINNESOTA	739,256	WEST VIRGINIA	7,800
MISSISSIPPI	9,318,183	WISCONSIN	952,360
MISSOURI	50,853	<b>TOTAL</b>	<b>1,143,340,901</b>



## TOP 25 KSC BUSINESS CONTRACTORS FOR FISCAL YEAR 2006

Contractor Obligated	Number of Contracts/Orders	Dollars
Space Gateway Support	1	372,218,803
McDonnell Douglas Corp. Delta Launch	1	244,801,717
Boeing Space Operations (McDonnell Douglas)	1	95,773,274
Lockheed Martin Comm. Launch Services	1	85,997,079
InDyne, Inc.	1	61,227,456
Orbital Sciences Corp.	1	41,795,273
ASRC Aerospace Corp.	2	39,711,764
Analex Corp.	1	18,810,262
OAO Corporation	2	18,326,641
Dynamac Corp.	2	17,192,512
Rush Construction Inc.	4	12,191,970
Sauer Incorporated	7	9,468,234
Air Liquide Large Industries US Limited Partnership	1	7,966,372
Cendant Mobility Services Corp.	1	7,553,136
Air Products & Chemicals Inc.	2	5,614,898
Praxair Inc.	10	5,008,424
Reynolds Smith and Hills Inc.	29	4,441,844
Interconn Resources Inc.	1	4,124,885
Tetra Tech NUS Inc.	19	3,858,183
Rush Peak Joint Venture	7	3,251,368
Speegle Construction Inc.	5	2,910,186
C and C International Computers and Consulting Inc.	1	2,612,407
Jones Edmunds and Associates Inc.	41	2,428,400
Hamilton Roofing Inc.	2	2,360,122
Seyforth Roofing Company Inc.	2	2,189,530
<b>TOTAL</b>	<b>145</b>	<b>\$1,071,834,740</b>

Johnson Space Center's Space Program Operations Contract, held by United Space Alliance, recorded \$566.8 million managed by the KSC Procurement work force in FY 2006.



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John F. Kennedy Space Center  
Kennedy Space Center, FL 32899

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