



Spaceport News

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John F. Kennedy Space Center



cape canaveral spaceport
MASTER PLAN

Spaceport Master Plan unveiled

Government and community leaders were introduced to a bold, enterprising plan for our future Aug. 27 as the Cape Canaveral Spaceport 50-Year Masterplan was officially set into motion.

Kennedy Space Center, the 45th Space Wing, the Florida Spaceport Authority and partners shared the results of the two-year project.

For highlights of the masterplan, see pages 4-5.

KSC wins most Space Act Awards

Center leads for 3rd year

For the third year in a row, Kennedy Space Center earned more Space Act Award dollars than any other NASA center.

The Space Act Awards program was authorized under the Space Act of 1958 to provide official recognition and to grant equitable monetary awards for those inventions and other scientific and technical contributions that have helped to achieve NASA's aeronautical and space goals.

The awards are also designed to stimulate and encourage the creation and reporting of similar contributions in the future.

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JIM HEALD
DIRECTOR
SPACEPORT ENGINEERING AND TECHNOLOGY

job in applying technology to real world problems," said Jim Heald, Spaceport Engineering and Technology director. "This achievement shows KSC is well on its way in achieving the vision of a Spaceport Technology Center.

"Of course, a large part of our Space Act Award program success is directly attributable to Pam Bookman's work with our researchers and innovators."

The fiscal year 2002 award

amount of \$190,850 is proportionately divided among the four areas of awards.

The software release area won \$51,600, patent application received \$23,000, *TechBriefs* was awarded \$47,600 and board action received the highest total at \$68,650.

This year's award dollars show a significant increase from the \$12,000 awarded 10 years ago.

(See AWARDS, Page 3)

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Crawler-transporter bearing issue resolved

The Shuttle will roll, thanks to a speedy but intensive investigation over the cracked bearings found in several Jacking, Equalizing and Leveling (JEL) cylinders on crawler-transporter number two (CT-2).

Shuttle mission managers have decided to repair the crawler by using existing good bearings, spare bearings already at KSC, plus eight new ones from the manufacturer expected by Labor Day. It takes about a day to remove each cylinder and replace the bearings.

The decision leaves CT-1 intact as a backup if needed. CT-1 will be repaired at a later date.

The cracked bearings were found during a planned cylinder refurbishment program the week of July 28. Four of the 11-foot JEL cylinders are located on each corner of the CT, for a total of 16, each with a bearing on either end making 32 bearings per crawler. Weighing 9,400 pounds each, the JELs provide vertical



Workers accompany the repaired Jacking, Equalization and Leveling (JEL) cylinder as it is moved from the repair site for installation into Crawler Transporter No. 2.

(See ROLL, Page 3)

Recognizing Our People

Jennings selected for NASA Headquarters post

Administrator Sean O'Keefe today announced James Jennings, Deputy Director of the NASA Kennedy Space Center (KSC) in Florida, has been selected as the Deputy Associate Administrator for Institutions and Asset Management at NASA Headquarters in Washington, effective Sept. 9.

Jennings, who has been with the agency for 35 years, has been KSC's Deputy Director since August 2000. He will be responsible for providing operational and management support for Headquarters and will direct a full range of activities relating to personnel and institutional management, reporting directly to NASA Deputy Administrator Frederick Gregory.

"Jim's diverse management experience with NASA makes him uniquely qualified for this position," Administrator O'Keefe



James Jennings

said in making the announcement. "He has literally watched this agency grow up from the front lines. Jim's leadership and resource management expertise are needed in Washington as we re-evaluate the way NASA manages its infrastructure and assets."

While Deputy Director at KSC, Jennings was responsible for assisting Director Roy Bridges Jr. in

determining and implementing center policy and in managing and executing center missions. He served as Acting Deputy Center Director in 1997 and as Director of the Administration Office from 1993 to 1997, where he was responsible for industrial labor relations, strategic planning, civil service personnel management and workforce analysis, continual improvement, university liaison and information management.

In 1987, Jennings became KSC's Deputy Comptroller, managing the preparation, defense and execution of the center's budget. Jennings' career has included management and analyst positions at the NASA Marshall Space Flight Center in Huntsville, Ala., and Headquarters.

Jennings has received numerous awards during his NASA career

including an Equal Employment Opportunity Award in 1975, an Exceptional Service Medal in 1988, the Equal Employment Opportunity Medal in 1989 and an Outstanding Leadership Medal in 1994. Jennings also received the Distinguished Service Award in 1989 and the President's Award in 1999 from the Space Coast Chapter of Federally Employed Women. He was conferred the rank of Meritorious Executive in 1997, and received the 1999 Presidential Distinguished Rank Award.

Jennings grew up in Alabama and received a Bachelor of Science Degree in Mathematics and a master's in Business Administration from Alabama A&M University in 1968 and 1973 respectively. He earned a master's in Administrative Sciences from the University of Alabama in 1979.

Professional Development graduates honored

Seventeen NASA employees were celebrated July 25 for their successful completion of the 2001-2002 NASA Professional Development Program (PDP).

In his address to the graduates, NASA Administrator, Sean O'Keefe reminded the class of their responsibility to mentor and share what they learned this past year.

O'Keefe said, "Part of your leadership responsibility now is to bring the energy and enthusiasm you have to help others improve."

He cited the framework of Secretary of Treasury, Paul O'Neil, and noted that NASA leaders need

- to create an atmosphere of respect and professionalism,
- give people the resources required to carry out their task, which means being honest with ourselves and making the tough judgment calls, and
- notice and recognize employees accomplishments, and when people



Two Kennedy Space Center workers recently completed the NASA Professional Development Program. From left, Richard Kuhns, KSC senior mission engineer; Sean O'Keefe, NASA administrator; and Adam West, lead orbiter electrical power distribution and control engineer.

are not successful, help them learn from their mistakes.

In her closing remarks, Chris Williams, the Program Director,

noted that the effectiveness of the Professional Development Program is determined by how well it enables participants to realize

"measurable results that matter to the American people."

Participants in the NASA Professional Development Program are competitively selected by their Centers, and they engage in a year-long intensive leadership development process that combines developmental work assignments, leadership development workshops, briefings by NASA's leadership, targeted training opportunities and individual coaching.

The goal of the PDP is to provide future leaders with a broader perspective of both the Agency and the impact of NASA programs.

This year's participant's from Kennedy Space Center were Richard Kuhns, a senior mission integration engineer in the International Space Station and Payloads Processing Directorate, and Adam West, lead orbiter electrical power distribution and control engineer in the Shuttle Processing Directorate.

Father of cochlear implant recognized

Retired NASA-KSC engineer Adam Kissiah's design is proof that technology developed today can benefit humankind years after its creation.

As a result of his hearing problem and three failed corrective surgeries, Kissiah began researching other rehabilitative possibilities. In 1977, with no medical background, he developed today's widely used cochlear implant.

That personal quest, that lasted three years, not only benefited him but many more. Popular radio talk show host Rush Limbaugh has credited the "medical marvel" for his ability to hear after a disease left him totally deaf in his left ear and 80 percent in his right.

Unlike a hearing aid, which just makes sounds louder, this invention selects information in the speech signal and then produces a pattern of electrical pulses in the patient's ear. It is impossible to make sounds completely natural, because a mere 22 electrodes are replacing the function of tens of thousands of hair cells in a normally hearing ear.

"It replaces the function of the hair cells that have been damaged, lost or destroyed by disease, drugs or trauma, or simply by inheritance," said Kissiah.

Kissiah uses an analogy to simplify the process. "It would be like all the inter-coastal waterway



Retired NASA engineer Adam Kissiah shows diagrams that help explain the cochlear implant he developed in 1977. Kissiah was recently honored with a Space Act Award for his innovation.

bridges in Florida being gone. If you were to suddenly remove all those bridges, there could be no communication from the mainland. The hair cells are the bridge – the mechanical part of the ear," he said.

Now, 25 years after the implant was patented, Kissiah is getting the recognition he deserves by receiving an exceptional category NASA Space Act Award, which includes an appropriate monetary award and a certificate signed by the NASA Administrator.

According to Pam Bookman, KSC's Awards liaison officer, this points out that we can always go back and capture awards. She also

explains that many employees fail to report these significant contributions because they think innovative thinking is just part of their job.

"Recognition for this important invention is long over due," said Bookman. "This is the largest award ever received by a KSC inventor."

The Space Act Awards program was authorized under the Space Act of 1958 to provide official recognition and to grant equitable monetary awards for those inventions and other scientific and technical contributions that have helped to achieve NASA's aero-

"Regardless of what level of participation I had, it's nice to know I contributed to making many lives better. That's special. It allows me to think that perhaps I did something that helps."

ADAM KISSIAH
RETIRED NASA ENGINEER

nautical and space goals. The awards are also designed to stimulate and encourage the creation and reporting of similar contributions in the future.

The fiscal year 2002 award amount of \$190,850 is proportionately divided among the four areas of awards, which are for software release, publication in *NASA TechBriefs*, Patent applications, and Board Action Awards.

Kissiah is humble but excited about the honor. "This is being done almost every day in medical centers in the country. Regardless of what level of participation I had, it's nice to know I contributed to making many lives better," he said. "That's special. It allows me to think that perhaps I did something that helps."

AWARDS ...

(Continued from Page 1)

A technology awards luncheon will be held on Oct. 8 at the KSC Visitor Complex Debus Center to honor NASA and contractor inventors for their technical contributions.

From Sept. 30–Oct. 4, KSC also will host the annual Technology Transfer Week.

Organized by the Technology Commercialization Office, Technology Transfer Week increases awareness of new technology reporting and commercialization activities such as licensing of technologies, dual use and partnerships, and the Space Act Monetary Awards program.

ROLL ...

(Continued from Page 1)

support for the Shuttle as it is moved to the pad. The cylinders, and the bearings, allow the surface of the CT to be adjusted to maintain a level plane as the CT crawls up the incline to the pad.

Without the leveling capability, the Shuttle does not move onto the launch surface.

An investigation included a review of maintenance records and failure analysis of material properties. System maintenance records were shown to be up to date on a program of bi-weekly operational checks, cylinder maintenance every six months, pre-mission and post-mission checkouts and inspection.

Engineering evaluation of the cracked bearings showed material properties of the components were according to specification when installed and the JEL cylinders were not overloaded. There was no indication the cracks occurred due to fatigue. However, analysis of the used grease in the bearings showed signs of degradation in lubricating capability. The decision was made to change the lubricant to the more heat-tolerant Caterpillar Desert Gold Grease, which has superior properties for application, and to use a product Loctite 660, to lessen rotation and aid press fit of the bearings.

Investigators considered several options to keep the Shuttles on track for launch. The first was to

use CT-1 as is; the second to rebuild CT-2 with existing good parts and new parts; and the third option to rebuild CT-2 with the best parts of CT-1 and CT-2 plus spares. Option two is being pursued to support a September rollout of Atlantis for mission STS-112.

The current launch schedule shows the Atlantis launch no earlier than Oct. 2. Launch of Endeavour on mission STS-113 is targeted for early November; Columbia's mission STS-107 is now targeted for no earlier than Jan. 16.

Future actions as a result of the analysis include investigating a new bearing design, reviewing the lubrication method, and reviewing bearing applications in other equipment.

Vision for the future

More than 40 years ago, NASA's Kurt Debus and Wernher von Braun envisioned hundreds of launches each year from what is now known as the Cape Canaveral Spaceport.

While that launch rate is still a dream as yet unrealized, such far-reaching vision and planning is what propelled the United States to the Moon.

Today, spaceport leaders see the potential for 250 or more launches a year sometime within the next 50 years. Much depends on breakthrough technologies that will lower the cost of launch from \$10,000 a pound to \$1,000, and then to far less than \$100 a pound.

In preparation for such breakthroughs and as a proactive move to remain the world's premier launch site, NASA Kennedy Space Center, the 45th Space Wing and the Florida Space Authority and their partners have created a Cape Canaveral Spaceport 50-Year Master Plan. The plan was unveiled Aug. 28 at Port Canaveral Terminal 10.

"We're sharing our vision with you today. This is not just a NASA thing or an Air Force thing or a Florida Spaceport Authority thing ..." KSC Director Roy Bridges told participants. "This represents the beginning of a partnership. This plan and the partnership created for it will help us go forward. The plan will adjust over time."

The plan represents interagency cooperation between the leadership group's agencies and the U.S. Fish and Wildlife Service, the National Park Service and U.S. Navy. Joining them in developing a vision of the Spaceport's future have been aerospace educators, researchers, and businesses, along with representatives from local, state and national government.

"There was participation from all levels (management and staff) both inside and outside the gates here, and without that, the project would not have been successful," said Renee Ponik, NASA KSC Master Planning Team Member.

The master plan was a two-year process conducted and managed by ZHA Incorporated of Orlando in association with Ponik and other spaceport representatives.

The vision embraces an integrated launch complex (including planning for the potential for horizontal launches), supporting joint operations for KSC and the Cape Canaveral Air Force Station, and consolidating facilities to avoid duplicate functions while increasing efficiency.

"Together we will ensure that the Cape Canaveral Spaceport remains the premier Spaceport in the world," Brig. Gen. Pavlovich said.

The long-term land use plan supports a market-based business model for the spaceport. Planning criteria were developed based on the vision adopted by the leadership group.

"This is a significant event. We have evolved into an era of cooperating agencies," said Ed Gormel, Executive Director of the Florida Spaceport Authority.

The resulting master plan is unique because there is no place like Cape Canaveral where launch pads share land with research and industrial facilities; where millions of tourists visit every year; where landing strips and port facilities exist within a wildlife refuge and near a national seashore, said Matt Taylor, ZHA vice president and chief planning officer.

"This plan is a guide to look at the short-term, long-term and future goals for the Cape Canaveral Spaceport," Taylor said. "The plan allows us to be good stewards of the environment for the long-term."

ZHA was chosen to conduct the spaceport planning because of its experience developing the master plans for Orlando International Airport and Orlando Executive Airport and others, along with its diverse experience with projects related to the Central Florida tourism and convention industries, ZHA was chosen to conduct Spaceport planning.

For more information on the masterplan, visit www.yourspaceport.com.







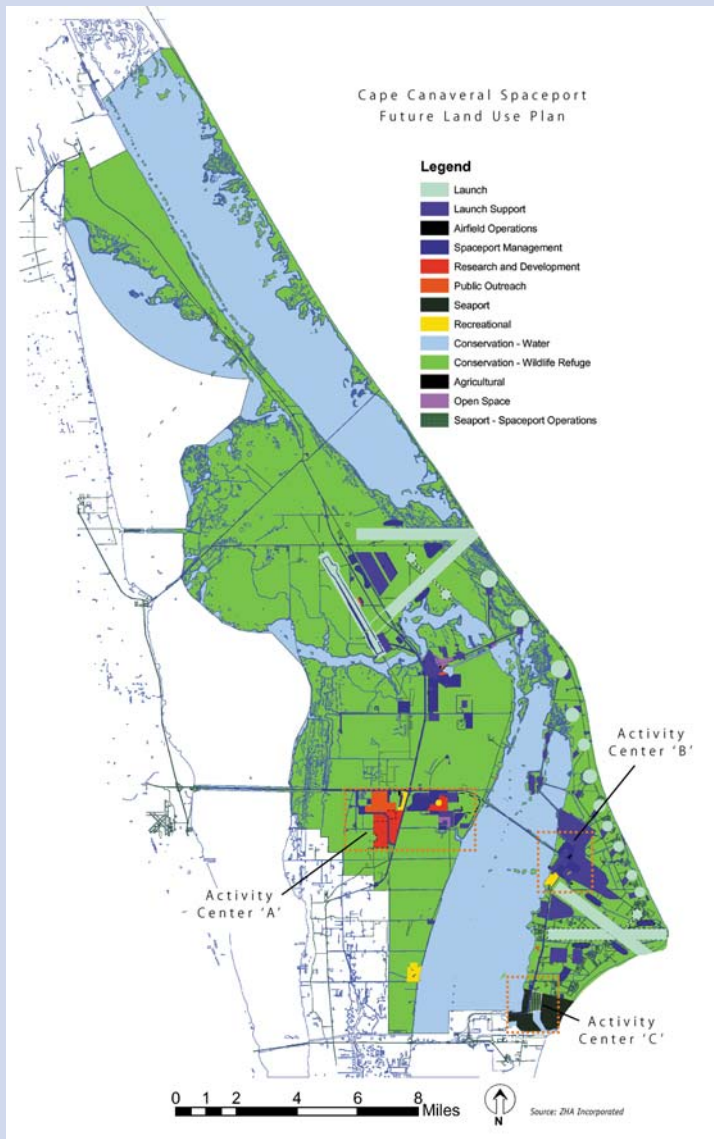
Canaveral spaceport
MASTER PLAN




Merritt Island
National Wildlife Refuge




Cape Canaveral Spaceport leaders gather after the master plan signing ceremony Aug 28 at Port Canaveral Terminal 10. From left are Canaveral National Seashore Superintendent Robert Newkirk, Canaveral Port Authority Executive Director Malcolm "Mac" McLouth, KSC Director Roy Bridges Jr., U.S. Sen. Bill Nelson, 45th Space Wing Commander Gregory Pavlovich, U.S. Fish & Wildlife Services Refuge Manager Ron Hight, Naval Ordnance Test Unit Commanding Officer William Borger and Florida Space Authority Executive Director Ed Gormel.



BCC Aerospace Technology kicks off

An average first day of college usually doesn't begin with a complimentary continental breakfast. Then again, the 29 fresh faces beginning their work in the Aerospace Technology program here at Kennedy Space Center aren't your average students either.

Brevard Community College settled at KSC's Center for Space Education last August to launch BCC's Aerospace Technician Degree Program and skill standards development process.

The program is an industry-driven initiative that provides a national skills standard for aerospace technicians. The program is monitored by the Aerospace Technology Advisory Committee (ATAC), a group of more than 40 industry, government and academic organizations working together to develop curriculum for future aerospace technicians.

"Our inaugural class is entering their second year of study, and our largest entering class so far [began] their first classes Aug. 19," said Dr. Albert Koller, BCC executive director of aerospace programs.

Applicants range from recent high school graduates to technicians with experience in the field. Students follow a two-year schedule of classes totaling 70 credit hours, including general courses and internships. Participants receive an Associate of Applied Science degree. Students wanting to prepare for additional college degree work can substitute general education courses for internships and receive an Associate of Science degree.

Dr. Sonny Witt, Vice Commander, Cape Canaveral Air Force Station; John Halsema, NASA Government Relations; Glenn Vera, Deputy Director, Florida Space Authority; and Rick Lengyel, Chief of Technical Training for United Space Alliance, spoke to the group about what to expect from the program and KSC.

They stressed the importance of the technical workforce and the paths they followed in their own careers, including modest beginnings as technicians during prior programs.

Dr. Koller encouraged the



At top, Dr. Albert Koller, Brevard Community College executive director of aerospace programs addresses students at Kennedy Space Center's Center for Space Education at the KSC Visitor Complex. Above, students prepare for class to begin.

students to understand that they'll soon make major contributions to the space industry, citing Guenter Wendt's book *The Unbroken Chain*. "Every link is important. Most of the links are technical people," he said. "The genesis of this program comes from that theory."

BCC's Spaceport Center obtained use of a launch pad and support facilities for technician training courtesy of the 45th Space Wing and the Florida Space Authority. Students will have access to Complex 47 launch facilities and Building 7800 at CCAFS for hands-on experience in launch procedures and standards.

A new major partnership with NIDA Corp. was also announced at the opening ceremony. NIDA is a local manufacturing organization providing electrical/electronic and fiber optics training devices and computer-based curriculum to the NAVY, the RAF, and many others for many years.

NIDA placed 16 new stations in the Technical Training Center at KSC's Visitor Complex. Those stations include computer-based training software modules for self-paced work. The programs track various aspects of student progress, problem areas and system effectiveness.

In addition, NIDA provided virtual instrumentation that replaces standard test equipment.

This equipment and software is being provided to the BCC Spaceport Center for one year at no cost. NIDA also offered training for instructors and technical support for laboratory operations.

Koller said, "This is a wonderful addition to an outstanding program, placing us among the leading organizations in the U.S. offering technical education at the post-secondary level."

For more information on the Aerospace Technician Program, call 321-449-5060 or visit www.spaceportcenter.org.

BCC SpaceTEC

The National Science Foundation awarded a \$3 million, three-year grant empowering Community Colleges for Innovative Technology Transfer (CCITT) to establish a National Aerospace Technical Education Center (SpaceTEC).

The grant award will initially run for three years and may be extended.

CCITT is a national consortium of community colleges with direct links to NASA and DoD Centers near respective colleges.

Brevard Community College is one of the nine institutions involved in the SpaceTEC initiative.

The goals of SpaceTEC are to foster interest in science, mathematics and technology education in the U.S. and to provide education for the technical workforce using a national alliance of representatives from business and industry, government agencies and academic institutions.

Graduates will be competent for employability; academic institutions will receive additional funding, access to relevant curriculum, program articulation and faculty development; and business and industry will be provided with a dependable source of well-trained, well-educated entry-level technicians.

"SpaceTEC will serve as a national resource to strengthen the nation's technical education base and motivate interest in academics," said Dr. Albert Koller, BCC executive director of aerospace programs.

For more SpaceTEC information, visit www.spaceteec.org.

KSC cheers Atlas V launch success

Kennedy Space Center cheered the successful first launch of the new Atlas V from Cape Canaveral Air Force Station's Launch Complex 41 Aug. 21.

The new Evolved Expendable Launch Vehicle (EELV) may carry some NASA payloads in the future.

KSC Director Roy Bridges Jr., and other NASA officials gathered at the Atlas Spaceflight Operations Center at Cape Canaveral Air Force Station (CCAFS) to watch the launch of the International Launch Services (ILS) Lockheed Martin Corp. vehicle carrying a Hot Bird 6 broadcast satellite for Eutelsat.

"We at KSC were thrilled by the successful launch of the Atlas V," said KSC Director Roy Bridges Jr. "It's excellent news for the space program in general and for us in particular as future potential customers for the new launch vehicle."

NASA has a contract with both Lockheed Martin and The Boeing

Co. for launch services.

The Atlas V launch received international attention because the standing of the U.S. space launch industry in a highly competitive global market depended upon a successful launch and satellite deployment.

The vehicle is the first EELV to fly. The Air Force partnered with Lockheed Martin and The Boeing Co. to develop two sets of EELVs to launch government and commercial satellites. The EELVs are designed to be less costly and more reliable than their predecessors. Boeing's EELV, the Delta IV, is scheduled to launch October 9.

NASA's Hangar AE at CCAFS hosted overflow government guests and KSC engineers who carefully tracked the launch.

"We always collect data on launch vehicles we use or may use. We watched this launch especially closely since this is a new vehicle," said Mike Benik, director of

Expendable Launch Vehicle Services at KSC. "The performance of the Centaur upper stage was also of importance because of the TDRS-J (Tracking and Data Relay Satellite-J) we plan to launch in November."

To support Atlas V missions, Lockheed Martin built a new launch complex at Cape Canaveral. The site introduces the "clean pad" concept to U.S. launch capabilities for the first time, consolidating the support operations into two facilities: the ASOC and the Vertical Integration Facility.

ILS' Atlas rockets and their Centaur upper stages are built by Lockheed Martin Space Systems Co. Astronautics Operations. ILS is a joint venture of Lockheed Martin and two Russian companies, Khrunichev State Research and Production Space Center and RSC Energia. ILS markets and manages the missions for the Atlas and the Russian Proton vehicles.



The Atlas V launch vehicle successfully lift off from Launch Complex 41 Aug. 21.



Mode VII simulation

Kennedy Space Center held a Mode VII contingency simulation August 27. "Astronauts" were safely and successfully recovered from a "downed" Space Shuttle in the simulation led by Don Hammel, NASA Landing and Recovery Director. KSC Fire/Rescue and Emergency Medical workers sharpened their skills during the event, which included NASA and Air Force helicopters. Johnson Space Center and Patrick Air Force Base personnel also participated in the simulation. At left, a volunteer dressed as an astronaut is carefully lowered from the the Fire/Rescue training Shuttle mockup. Below, rescue workers carrying an "astronaut" to an emergency medical vehicle. Mode simulations are periodically held at KSC to ensure contingency response forces are well prepared to respond to a wide variety of potential emergency situations.



25 years ago: Voyager I & 2 missions launch

A quarter-century after NASA's twin Voyager spacecraft departed Earth to visit outer planets – Voyager 2 on Aug. 20 and Voyager 1 Sept. 5, 1977 – the historic mission continues to fly a race against time.

During the first 12 years after launch from Launch Complex 41 at Cape Canaveral, the Voyagers chalked up a wealth of discoveries about four planets and 48 moons, including fast winds on Neptune, kinks in Saturn's rings and volcanoes on Jupiter's moon Io. As scientists and engineers mark the mission's silver anniversary, they hope at least one Voyager will pass beyond the boundary of the Sun's influence before the onboard nuclear power supply wanes too low to tell us what's out there.

Voyager 1 is now the most distant human-made object, about 85 times as far from the Sun as Earth is. Voyager 2 is now about 68 times the Sun-Earth distance.

Terry Terhune, with the Goddard Space Flight Center office at Kennedy Space Center, remembers the successful launches and others that led up to them.

"The Viking Program Launch Operations was impressive to me because of the co-operation of the multi-organizational interfaces and the short turnaround time between launches under adverse circumstances," said Terry Terhune, who then served as head of KSC Engineering of Titan/Centaur. "The Voyager Program Launch Operations refined those organizational interfaces and additionally demonstrated an extraordinary technical and creative ability to recover from and work around problems that ordinarily would have precluded either launch.

"I am still in awe of the operational and technical co-operation to overcome seemingly unsurmountable hardware failures. All of this before we knew what "risk management" was. We just asked the knowledgeable folks, 'what can we do and how can we do it?'"

JPL, a division of the California Institute of Technology in Pasadena, manages Voyager for NASA's Office of Space Science, Washington.

The Voyager team at JPL still receives information almost daily from the durable spacecraft traveling beyond all the planets.

"After 25 years, the spacecraft are still going strong," said Dr. Edward Stone, Voyager project scientist since 1972 and former director of NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif. "Back in 1977, we had no way to know they would last so long. We were initially just on a four-year journey to Jupiter and Saturn."

Voyager 1 flew past Jupiter and Saturn, then angled northward out of the plane of the planets' orbits. After Voyager 2 completed its tour of Jupiter and Saturn, NASA extended the spacecraft's adventure with flybys of Uranus in 1986 and Neptune in 1989.

The Voyagers now are examining the far reaches of the solar wind, a gusty flow of particles hurled outward by the Sun. The eventual goal is to become the first spacecraft to taste interstellar space.

"A radio signal traveling at the speed of light takes nearly 12 hours to travel between Voyager 1 and Earth. That raises operational concerns," said Ed Massey, Voyager's project manager at JPL. "If something went wrong on board, at least a full day would lapse before a signal revealing the problem could reach Earth and commands to fix it could be returned. It could be too late."

So the project team tries to anticipate any emergencies and program the spacecraft's computers with advance instructions on how to react to them, he said.

Both spacecraft are studying the vast bubble the Sun inflates around itself by outward pressure of the solar wind. The bubble has a boundary, called the heliopause, where this outward pressure is counterbalanced by inward pressure of the interstellar wind in our neck of the galaxy. The interstellar wind outside that boundary is a flow of atoms and other particles blasted from explosions of dying stars.

The location of the heliopause varies with the level of solar activity during the Sun's 22-year sunspot cycle and with changes in

Remembering Our Heritage




Voyager 1 was launched atop Titan/Centaur 6 at Launch Complex 41 at 8:56 a.m. EDT Sept. 5, 1977, joining its sister spacecraft, Voyager 2, on a mission to the outer planets.

the interstellar wind, Stone said. Some scientists suggest that, on a much longer time scale, the interstellar wind may occasionally press the boundary far enough inward to sway Earth's climate.

Voyager 1 is rushing toward the heliopause at about one million miles a day. Whether it gets there before about 2020, while it still has

adequate electrical power, depends on how far away the heliopause is. Recent estimates are that, depending on that distance, it would take Voyager 1 between seven and 21 years to reach the heliopause.

More information about Voyager is available at <http://voyager.jpl.nasa.gov>.



John F. Kennedy Space Center

Spaceport News

Spaceport News is an official publication of the Kennedy Space Center and is published on alternate Fridays by External Relations and Business Development in the interest of KSC civil service and contractor employees. Contributions are welcome and should be submitted two weeks before publication to the Media Services Branch, XAE-1. E-mail submissions can be sent to Katharine.Hagood-1@ksc.nasa.gov

Managing editor..... Bruce Buckingham
Editor..... Kathy Hagood

Editorial support provided by InDyne Inc. Writers Group.
NASA at KSC is located on the Internet at <http://www.ksc.nasa.gov>

USGPO: 733-133/600016