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Spaceport News

America's gateway to the universe. Leading the world in preparing and launching missions to Earth and beyond.

John F. Kennedy Space Center

Mission update

As inspections and repairs of electrical wiring continue, Space Shuttle managers recently announced tentative target launch dates for the next two Shuttle missions — STS-103 and STS-99.

Managers established STS-103, the Hubble Space Telescope Servicing Mission 3A, as the next Shuttle flight with a launch targeted for no earlier than Oct. 28. A target launch date of no earlier than Nov. 19 was set for the launch of STS-99, the Space Radar Topography Mission.

These are target dates only and subject to change, depending on the progress of the current wiring work.

"We've established these planning dates so that those involved in flight preparations can establish the proper order of priority for work on each mission," Space Shuttle Program Manager Ron Dittemore said. "However, we are continuing to review the progress of wiring inspections and repairs on Endeavour and Discovery and, as part of our continuing evaluations of those activities, we may need to revisit the subject and further adjust our target launch dates as those repairs progress."

The wiring work was deemed necessary following a short circuit that occured during Columbia's July liftoff of STS-93. The Shuttle made it safely into orbit using backup computers, but fleetwide inspections were ordered to make sure no other wiring problems existed.

Where next, Columbia? Palmdale, California

She's the oldest member of the family and tips more pounds on the scales than her sister ships, but anyone who has ever worked with her will tell you she's a real workhorse and a star performer.

The orbiter Columbia, commonly referred to as OV-102 for Orbiter Vehicle 102, is a pioneer. She was the first Space Shuttle to fly into Earth orbit in 1981, holds the record for 11 of the 12 longest Shuttle missions and for the fastest turnaround between flights (56 days), and was the first orbiter to undergo scheduled inspection and retrofitting.

Now, after her 26th flight, Columbia is scheduled to leave KSC on Sept. 23 for another scheduled maintenance period, known as an Orbiter Maintenance Down Period, or OMDP. She is scheduled to arrive at Boeing's orbiter assembly facility in Palmdale, Calif., on Sept. 24, and not return to KSC until July 2000.

Orbiters are disassembled almost down to the airframe at the Palmdale factory for an extensive and vigorous inspection process that analyzes every part of the vehicle. Even difficult-to-reach areas around the antennae are examined.

Many thermal protection tiles will be removed to get to where the antennae are stored so special X-ray equipment and a video borescope can look for areas of possible trouble. (A borescope is a snake-like fiber optic camera that can see in tight spaces.) The same equipment will be used to inspect hard-to-reach areas of the entire orbiter.

One of the goals for the most experienced orbiter in the fleet (tied only with Discovery for the number of flights to date) is to shave off a few of her extra pounds.

(See Columbia, Page 4)

The Space Shuttle Columbia blazed a trail for others to follow when it made history on April 12, 1981, lifting off on STS-1. The primary mission objectives of the two-day maiden flight were to check out the overall Shuttle system, accomplish a safe ascent into orbit and return to Earth for a safe landing. All of these objectives were met, proving the Shuttle's worthiness as a space vehicle. Although the orbiter sustained some tile damage on launch and from an overpressure wave created by solid rocket boosters, Columbia came through the flight with flying colors and flew the next four missions.

How do you get a space station off the ground?

For the Space Station to perform optimally in space, it has to work well on the ground first. Find out how KSC technicians and engineers test the many elements of the Station before it gets off the ground. See story, page 6.

Mars Polar Lander landing site selected

A strip of gentle, rolling plains near the Martian south pole will serve as a welcome mat when NASA's Mars Polar Lander touches down on the red planet on Dec. 3.

NASA unveiled the landing site, a swath of terrain measuring about 1,500 square miles, at a briefing Aug. 25 at NASA Headquarters, Washington, D.C.

The landing site is located near the northern edge of the layered terrain in the vicinity of the Martian south pole.

"We believe this layered terrain is a record of climate changes on Mars and, in a sense, digging into its surface will be like reading tree rings or layers in an ice core," said Project Scientist Dr. Richard Zurek of NASA's Jet Propulsion Laboratory, Pasadena, Calif.

"The presence of fine layers of dust and ice with varying thickness will indicate changes in weather patterns and layer formation that have been repeated in recent history," he added. "In addition, we may find evidence of soil particles that formed in ancient seas on Mars and were later blown into the polar regions."

The site was selected after the project team studied pictures and altimeter information gathered by NASA's Mars Global Surveyor, which is currently orbiting the planet.

The search was narrowed to four sites before the final location was chosen. A backup landing site is located nearby.

The Dec. 3 landing will occur toward the end of spring in the Martian southern hemisphere.

The sun will shine all day, moving higher and lower in the sky but never dipping below the horizon. This nonstop sunshine will power the lander's solar panels for 90 days, until the Martian seasons change and the lander's mission ends.

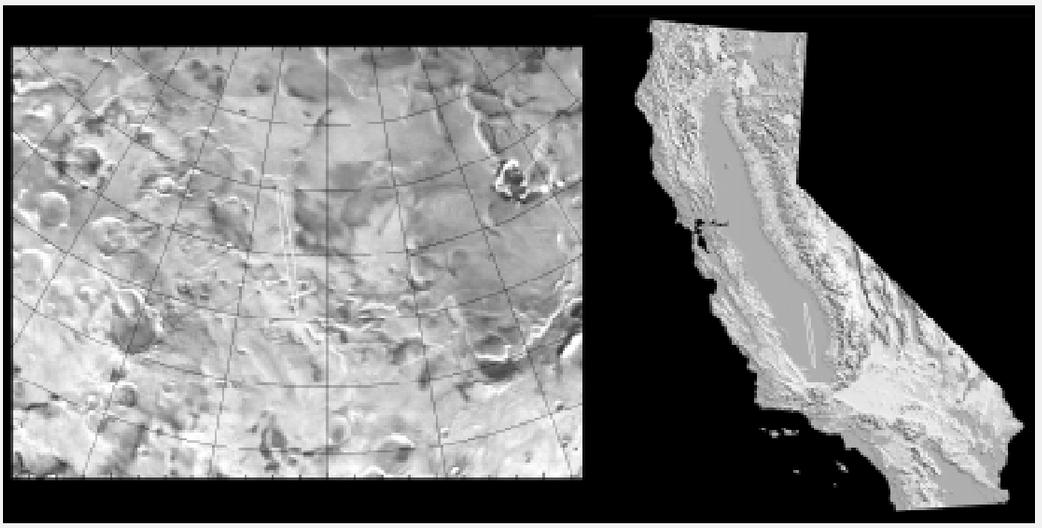
Launched on Jan. 3, 1999, from Cape Canaveral Air Station, Mars Polar Lander will study the soil and look for ice beneath the surface of the Martian south pole.

Kennedy Space Center is the lead center for the acquisition and management of expendable launch vehicle (ELV) launch services.

The lander also carries two Deep Space 2 microprobes that will be deployed about five minutes before the spacecraft enters the Martian atmosphere. The microprobes will smash into the planet's surface and penetrate the soil to look for water ice. The microprobes were developed under NASA's New Millennium Program.

Images of the landing site and additional information about Mars Polar Lander are available at the following web site *http://mars.jpl.nasa.gov/msp98/lander/*

Additional information about Deep Space 2 is available on the web at *http://nmp.jpl.nasa.gov/ds2/*



Comparison of the Mars Polar Lander (MPL) landing site region with California. The left half of the figure shows a map of Mars' south polar region created from Viking images. The cratered surface is blanketed by sedimentary layers of ice and dust up to two kilometers thick. South is at the top of the map and the illuminatIon is from the bottom. The right half of the image is a digital elevation model of the state of California overlain with MPL's landing ellipse. The scale of this map has been reduced by a factor of two relative to the Mars map. Below, the Mars Polar Lander launched from Cape Canaveral Air Station's Launch Pad 17B on Jan. 3, 1999. This unusual view of the boosters falling from the rocket was taken from a camera mounted on the side of the Boeing Delta II rocket.

KSC celebrates Hispanic Heritage Month Sept. 15-Oct. 15

Kennedy Space Center will celebrate the Hispanic Heritage Month from Sept. 15-Oct. 15.

The central theme for this year's observance is "Hispanics: Looking Forward to the 21st Century."

The activities include the annual luncheon and an art exhibition.

The Hispanic Employment Program Working Group will hold its fifteenth annual "Meet your Directors' Luncheon" on Friday, Oct. 8 at 11:30 a.m. at the Lunch Pad cafeteria at the Visitor Complex.

Employees are invited to join in this year's observance and to participate in the planned activities.

The luncheon program will feature a guest speaker and Spanish songs performed by local talent.

The menu will consist of paella, roast pork, beans and rice, roasted corn, tortillas and salad.

The tickets are $10 per person and available from Joe Tellado at 867-6064.

An art exhibition from Hispanic artists will be displayed at the KSC Visitor Complex.

Additional information on the exhibit will be provided in *Countdown*, the *KSC Bulletin*, and the Postmaster's 10 o'clock News.

For more information on this year's activities, please contact Rey Diaz at 867-1160 or Maria Lopez-Tellado at 867-9494.

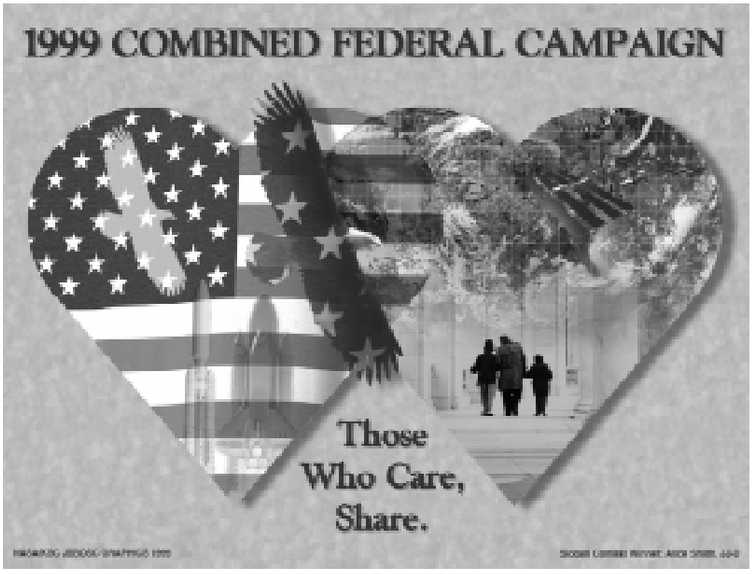
Saturn-bound Cassini takes a close look at Earth's moon

New images and brief movies of the Earth's moon, taken by the camera system on NASA's Saturn-bound Cassini spacecraft when it flew by Earth four weeks ago were recently released by the Cassini Imaging Team. Cassini's images can be viewed at *http://condor.lpl.arizona.edu/* .

Cassini, launched Oct. 15, 1997, from Launch Complex 40 on Cape Canaveral Air Station, flew past Earth to gain enough energy to reach distant Saturn in 2004, where the spacecraft will make detailed studies for four years.

The images released include a wide-angle movie, a narrow-angle video clip, the moon in ultraviolet and a "triptych" (a three-paneled composite image) of the moon. They were taken from a distance of about 234,000 miles about 80 minutes prior to Cassini's closest approach to Earth. No images of Earth were planned or taken during Cassini's flyby.

KSC's CFC set to begin



This year's KSC Combined Federal Campaign (CFC) will officially open with a kick-off rally in the Training Auditorium at 9 a.m. on Oct. 1.

The campaign will begin that day and will run through Oct. 31.

All NASA employees are invited to the kick-off rally to learn more about the Combined Federal Campaign and where their contributions will go.

This campaign is the time for NASA employees to reach out and support less fortunate people in the local community, our nation and throughout the world.

Last year, Kennedy Space Center federal employees generously contributed $229,000 — exceeding the campaign goal of $210,000.

This year's goal is $216,000.

Guest speakers at the kick-off rally will include Brenda Harris, executive director, Exchange Club Center for the Prevention of Child Abuse (also known as Yellow Umbrella) and Rob Raines, president, United Way of Brevard.

Training for unit coordinators and key solicitors will be conducted immediately following the kickoff program.

Unit coordinators and key solicitors will personally share the message of the campaign with all employees.

A contest was held to come up with this year's campaign slogan.

The winning slogan, submitted by Alice Smith, Environmental Program Office, is "Those who care, share."

As the winner of the slogan contest, Smith will receive two VIP passes to an upcoming launch.

All Combined Federal Campaign contributors will be eligible to win a prize in a weekly drawing to be held during each of the four weeks of the campaign, as well as being entered for the grand prize drawing to be held at the conclusion of the campaign.

Weekly drawing prizes are still being finalized, but the grand prize will be provided by Center Director Roy Bridges in the form of two passes on the center director's bus for a future launch and a photo of the winner with Bridges.

Information concerning the campaign can be found on the Kennedy Space Center Combined Federal Campaign website at *http://cfc99.ksc.nasa.gov/*

This website will be activated on Oct. 1.

It will include an on-line contribution form and brochure which will make participation in Combined Federal Campaign even easier.

Barbara Brown, NASA chief information officer, is Kennedy Space Center's 1999 Combined Federal Campaign chairperson.

Brown is hopeful that contributions will again exceed the campaign goal set for this year.

OPEN HOUSE

The 1999 KSC/Cape Canaveral Air Station Employee Open House has been rescheduled for Saturday, Nov. 6.

The event, with the theme "Space Partners Opening the Gateway to the Future," includes Kennedy Space Center, Cape Canaveral Air Station (CCAS) and the Naval Ordnance Test Unit.

The event, which is open to all KSC and CCAS badged employees and their guests, will run from 9 a.m. to 3 p.m. Many of the most popular facilities at KSC and CCAS are scheduled to be open, and other planned highlights include appearances by several astronauts. Food services will be provided as well.

At least one badged employee must be in each vehicle, which can be no larger than a 15-passenger van.

More information will be published in future issues of KSC *Countdown* and *Spaceport News*. A detailed brochure including maps of the open facilities will be mailed to employees before the event.

Columbia ...

(Continued from Page 1)

"Columbia is a heavy vehicle because she has a lot of additional wiring and instrumentation left over from her initial development, being the first orbiter for actual flight," commented George Jacobs, NASA OV-102 lead project engineer. "We're going to remove some of that additional wiring, known as development flight instrumentation [DFI] at Palmdale."

In addition to the removal of its DFI wiring, Columbia will have a full wiring inspection covering much of the main electrical wiring from nose to tail. When completed, technicians will have inspected roughly 100 miles of electrical wiring for Columbia, as they will have in each of the four Shuttle orbiters.

Orbiter electrical wiring inspections and repairs were scheduled for each of the orbiters after a short occured on the flight of STS-93 in July. Other wiring upgrades scheduled for Columbia's maintenance period include making the vehicle capable for an orbiter docking system. Columbia is the only one of the fleet without that capability at present.

"We will put in the wiring for the orbiter docking system from the crew module to the interface in the payload bay," said Jacobs.

This will give the Columbia ground crew the flexibility to be able to add an external airlock to Columbia here at KSC, if necessary.

"We're not going to replace Columbia's internal airlock with an

Above, Shuttle Columbia rolled out to KSC's Pad 39B for STS-87, a 16-day flight of the United States Microgravity Payload-4 mission. This mission also featured a spacewalk to demonstrate assembly and maintenance operations for future use on the International Space Station.

Above, the orbiter Columbia is lifted on Oct. 24, 1997, in KSC's Vehicle Assembly Building transfer aisle in preparation for mating to its solid rocket boosters and external tank before roll-out to Pad 39B for STS-87. The external tank and solid rocket boosters are stacked and mated on a mobile launcher platform prior to mating with an orbiter. Orbiter connections then can be made, and the fully integrated Shuttle vehicle is then checked and ordnance is installed. If the payload was not installed in the Orbiter Processing Facility, it will be installed at the launch pad followed by prelaunch activities. Below, on March 31, 1981, Columbia waited patiently on Pad 39A showered with lights in a nighttime preparation for a Flight Readiness Firing at KSC prior to STS-1.

external airlock, like the other orbiters have for docking with the International Space Station, but by adding the wiring for the docking system, this will give Columbia the ability to receive an external airlock should the opportunity arise for her to dock with the International Space Station," Jacobs noted.

Columbia is not scheduled in the current launch manifest to dock with the Space Station.

The addition of an external air lock at this time would take away from one of Columbia's unique features — her big belly.

"We want to keep the 60-foot cargo bay because there are still payloads, like the Chandra X-ray Observatory, that only Columbia could fly," he stated.

The largest payload ever to be launched by a Shuttle, Chandra — at more than 45 feet in length and weighing more than five tons — could only have been launched by another orbiter in the fleet if the orbiter had its external airlock removed, but then the flight crew would have lost the capability for spacewalks during the mission, which is an option best left open in case there's a concern with the payload on orbit.

Chandra had its own maintenance issues, too, before it could get off the ground, so the crackerjack Columbia team on the ground took advantage of the extra time before flight to shave off a few pounds before the liftoff of STS-93.

"Because our mission kept getting delayed due to payload issues, we took time to perform a few initial weight savings modifications," Jacobs recalls. "They're little things, but they all add up. For example, there used to be two layers of aluminum tape inside on the walls of the landing gear, inside the wheel wells. We replaced those two layers with one layer, which may only be a few pounds, but it makes headway before the OMDP in Palmdale."

The team was able to complete some weight-savings measures here at KSC, while others will have to be completed when Columbia reaches Palmdale. There, Columbia is also scheduled to receive a space-to-space orbiter radio, intended to facilitate communication between Shuttle crew members, space-walking astronauts and the International Space Station crew members without relying on ground stations for transmission.

Left, with sunrise just minutes away, the STS-80 mission concluded with a perfect landing by Columbia at KSC's Shuttle Landing Facility, runway 33. Below, the recovery convoy crew greeted Columbia following main gear touchdown of STS-80 on Dec. 7, 1996. Prior landing attempts on Dec. 5 and 6 were scrubbed due to weather conditions, and the extended time aloft allowed the five-member crew to set a (then) new record for long-duration Shuttle flight. At main gear touchdown, mission duration was 17 days, 16 hours. The current launch manifest has Columbia scheduled for another long-duration mission in late 2000 — with about a 16-day mission.

Columbia is scheduled to receive wireless video capability, too, for use during extravehicular activity, or spacewalks.

In addition to becoming "docking-ready," Columbia will receive the capability to use a global positioning system, or GPS, while on orbit. Although the system may not be used in her next few flights, it will be ready for use once the system has proven its effectiveness on orbit.

Perhaps one of the most extensive parts of the overhaul for Columbia, however, will be the addition of a multi-functional electronic display system (MEDS), also known as the "glass cockpit."

During Columbia's cockpit modification, all of the old dials, gauges and knobs will be replaced with the latest in computer technology, similar to work already completed on Atlantis.

Finally, added protection will be a part of Columbia's OMDP. A radiator impact protection modification will be performed to protect the coolant lines on the outside of the orbiter from any possible orbital debris.

Although the overhaul is both necessary and good for Columbia, OMDP isn't always a welcome time in an orbiter's life.

"The crew that works on the vehicle day in and day out will miss Columbia," said Jacobs, but their devotion and attention to detail doesn't go unnoticed.

"One of the comments we had from the flight crew of STS-93 was that it was the cleanest vehicle they'd ever seen," Jacobs added. "Since the vehicle had been grounded for more than a year prior to that flight, that was a real compliment."

Above, the orbiter Columbia was towed from KSC's Shuttle Landing Facility to the Vehicle Assembly Building on March 25, 1979, two years before its first orbital flight.

Destination: Station — MEIT places ISS one step closer to next launch

The ground testing, known as the multi-element integration test (MEIT) program, for the International Space Station (ISS) has finished a significant number of the test objectives identified for completion this year.

These tests have yielded important flight readiness data for engineers who are preparing the hardware for launch at KSC's Space Station Processing Facility (SSPF).

Parts of the Space Station are being powered up and initialized in the same order as astronauts and cosmonauts will activate them in space.

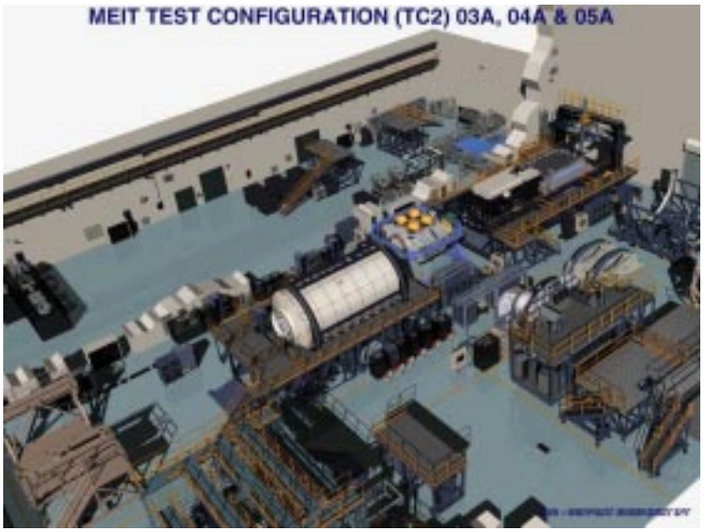
"We run these tests in order to minimize problems or additional work for the crews in space," said John Straiton, NASA chief of the MEIT Implementation Office. "We have to be sure before we send the elements up that we've done as much as possible on the ground to assure the elements perform together on orbit."

The tests include checks of power, data and fluid systems interconnections, and element software and hardware. While there have not been many hardware problems, there have been some software problems that require additional work and retest.

The MEIT program is divided into three phases. A fourth phase is under development. Each phase is also segmented into test configurations and subsets called "slices."

As an example, engineers recently completed Phase I of test configuration 4 (TC4) for the U.S. Laboratory "Destiny" and the Canadian remote manipulator system, both of which are to be launched next year.

It is crucial that the lab and the arm's electronic systems are fully compatible because the lab will house a portable computer system that will operate everything on the Station. The astronauts will be able to manipulate the arm from within the lab using an integrated video system receiving live pictures from cameras positioned on the arm and the Station's structure.



Initially, all assembly operations will take place outside of the lab, so it is extremely important that the astronauts can see all views associated with everything they'll need to accomplish their tasks," said Jim Werpy, a primary test conductor for Boeing. Their team is supporting NASA and the international partners as well as other contractors working on the ISS program at KSC.

"We're fortunate to have a great civil service and contractor team working together on MEIT," he continued.

"That's especially important when you have to work on unanticipated anomalies that occur during testing, particularly when late into the night or on weekends," said Straiton. "You really need a good, reliable team."

During the MEIT testing, engineers and technicians often worked around the clock, seven days a week in three shifts to complete the battery of complex tests. As the effort progressed, the MEIT test team had the opportunity to modify several key processes and procedures to gain efficiency which ultimately contributed to the success of the test.

For the remainder of the year, the test team will perform regression slices of TC2 (Z1 and P6 elements and the laboratory) and TC4 to retest software and hardware "fixes."

Phase I of MEIT is expected to be fully complete in February 2000. Phase II will begin next April.

This will be followed by Phase III that will include tests of the Japanese Experiment Module and Node 2, a pressurized element similar to Node 1 (Unity) which is already in orbit with the Russian-built Zarya.

Elements for the next five assembly missions of the International Space Station are currently undergoing integration in the SSPF and have participated in various stages of MEIT testing.

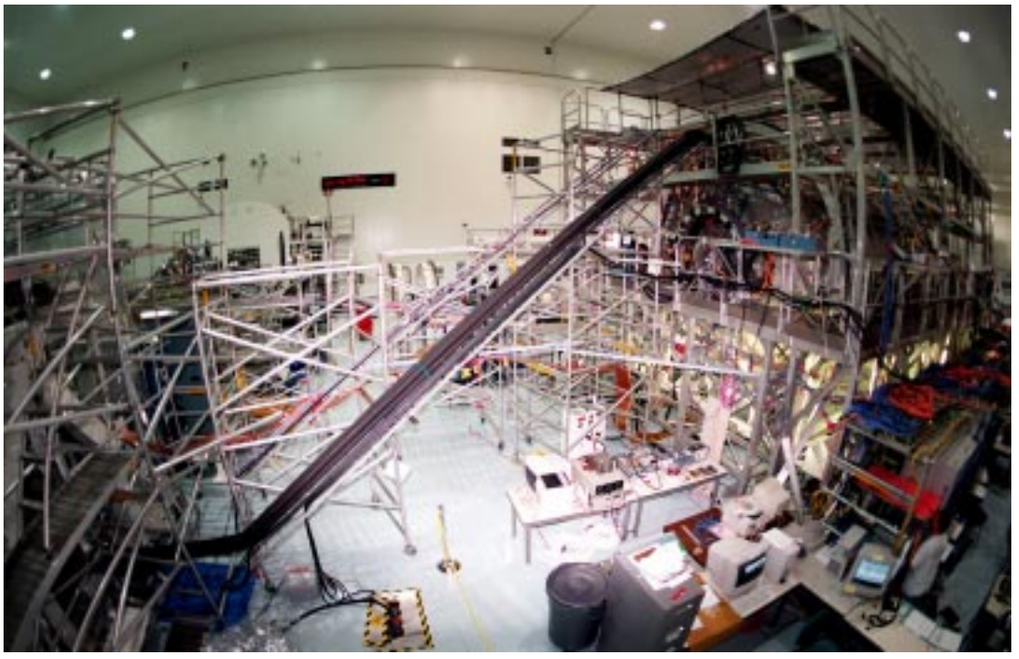
After the regression tests are complete, the next major objective will be an end-to-end (ETE) test and a Mission Sequence Test (MST), set to begin before the end of December 1999.

The ETE communications test will connect the flight hardware in the SSPF with Mission Control in Houston via the Tracking and Data Relay Satellite (TDRS). This test will verify the communication links and the ability of the Mission Control flight controllers to command and monitor the flight elements as they will once the hardware is on orbit.

The MST will be a dress rehearsal of the activities once the elements are initially on orbit.

The actual timelines will be validated using crew procedures, just as on orbit. This will involve flight crew members, who will come to KSC to participate, and the Mission Control flight controllers at Johnson Space Center in as close to final flight hardware and software configuration as can be performed on the ground.

Subsequent to the MEIT completion, the flight elements will go through final preparations, close-outs, and readiness for launch.

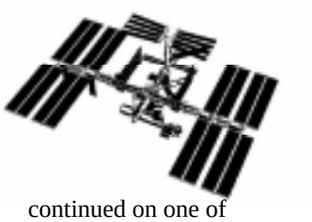


A Multi-Element Integration Test (MEIT) was performed in KSC's Space Station Processing Facility to ensure that components of the International Space Station (ISS) work properly together before they are launched into orbit. Within the framework at right is the U.S. Lab, called Destiny, and at left is the Z-1 truss. The most recent MEIT combined the P-6 photovoltaic module, the Z-1 truss and Pressurized Mating Adapter 3. Electrical and fluid connections were hooked up to verify how the ISS elements operate together.

Space Station news

The International Space Station's systems continue to function normally, with no major problems.

Troubleshooting



continued on one of the Space Station's six batteries (Battery No. 1), which is not being used to provide electrical power. This battery is to be replaced by the STS-101 crew and may be returned to Earth for examination.

Instruments have indicated the battery was charging and discharging in an unpredicted manner.

Five other batteries continue to provide adequate power for the Space Station.

The Russian-built Service Module will be the third element to be attached to the orbiting station. The module is now scheduled for launch from the Baikonur Cosmodrome in Russia in November.

The Space Station is oriented with Unity pointed toward Earth and Zarya pointed toward space in a slow spin to conserve fuel. The Station is in an orbit with a high point of 244 statute miles and a low point of 234 statute miles, circling the Earth every 92 minutes.

The complex has completed more than 4,550 orbits since launch of Zarya last November.

Space Station viewing opportunities worldwide are available on the Internet at *http://spaceflight.nasa.gov/realdata/sightings/*

SeaWinds keeps track of iceberg in Antarctica

A NASA satellite instrument is keeping an eye on an iceberg the size of Rhode Island, the first time this space technology has been used to track a potential threat to international shipping.

NASA's orbiting SeaWinds radar instrument, flying aboard the "QuikSCAT" satellite, will monitor Iceberg B10A, which snapped off Antarctica seven years ago and has since drifted into a shipping lane. SeaWinds launched from Vandenberg Air Force Base on June 19, 1999, aboard a Titan II rocket. KSC is the lead NASA center for the acquisition and management of expendable launch vehicle launch services.

The iceberg, measuring about 24 miles by 48 miles, was spotted by the instrument during its first pass over Antarctica, demonstrating SeaWinds' all-weather and day-night observational capabilities. The massive iceberg extends about 300 feet above water and may reach as deep as 1,000 feet below the ocean's surface. It is breaking up into smaller pieces that could pose a threat to commercial, cruise and fishing ships.

Although conventional methods of tracking sea-surface ice are usually sufficient for tracking large pieces of ice, icebergs can sometimes disappear in the poor visibility of dark, cloudy Antarctic winters.

Drumming up a solvent solution

Webster's Dictionary provides one definition of the word *solvent* as "something that provides a solution."

In the case of a recent study of ozone-depleting substances for the Shuttle Program, it meant *someone* providing a solution.

NASA Propellants Engineer Chuck Davis, in the Logistics Operations Directorate, had been working on the study when members of the NASA Space Shuttle Program Launch Integration Office and the USA Logistics group determined that 247 more drums of S113 cleaning solvent would be needed above KSC's existing inventory in order to continue operations until 2020.

The Shuttle is planned to fly until at least that year.

S113 is used to precision clean critical Shuttle flight components that are not able to be cleaned with any of the new non-ozone depleting substance cleaning solvents or the recently implemented aqueous cleaning method.

"I had already talked with our supplier about buying some additional S113," said Davis." This would most likely be the last opportunity to buy any 'new' S113 since production had actually ceased in 1995."

In discussing the situation with a colleague, Davis learned that a Defense Logistics Agency (DLA) Ozone Depleting Substances Reserve (ODSR) in Virginia may have extra S113 available. After several days and numerous phone calls to various organizations, Davis located the administrator of the ODSR depot and told him what KSC was seeking. The administrator told Davis he'd have to look into the situation and get back to him.

Part of the team that worked on getting the solvent to KSC included, left to right in the front row, Tim Gibbs, Space Gateway Support (SGS); Jim Newberry, Defense Logistics Agency (DLA); Keith Walters, DLA; Steve Manning, DLA; Juan Santos, SGS; and Chuck Davis, NASA. On the fender is Brad Freed, SGS.

A few days later, Davis received a phone call back with the good news.

There were more than 300 drums of the S113 solvent located at a DLA depot in Lathrop, Calif., that the DLA had planned on 'excessing,' and it was available to NASA through an interagency exchange — at no acquisition cost!

Now Davis and his team needed to see if the solvent met the requirements for KSC's needs. After a trip out to the Sharpe Depot in Lathrop, Davis and a team determined that it was exactly what the Shuttle Program needed.

Letters were exchanged between NASA and the DLA to agree to transfer the solvent, worth about $2.6 million, for the cost of transportation.

Not only did this save NASA millions of dollars, it saved the Defense Logistics Agency the cost of disposing of the solvent.

Davis and eight individuals from Space Gateway Support went out to California with two tankers, a railroad tank car and several boxes of tools, hoses and pumps to salvage the solvent for the Shuttle program.

During the trip, it was so hot that the solvent in the drums was actually boiling (boiling point is 117F) while the technicians pumped the solvent from the drums into the tankers.

The tankers carried the solvent cross country back to KSC in September.

The railroad tank car is due back at KSC this month.

Hubble Space Telescope repair crew prepare for stellar results

Images from the Hubble Space Telescope, such as this dying star at right, provide us with more than just a stellar light-show. Hubble's images define for astronomers how these stellar outbursts provide a way for heavier elements, such as carbon, cooked in the star's core, to be ejected into interstellar space as raw material for successive generations of stars, planets and, potentially, life.

This troupe of galaxies, the Hickson Compact Group 87, performs an intricate dance orchestrated by the mutual gravitational forces acting between them. The dance is a slow, graceful minuet, occurring over a time span of hundreds of millions of years. This galaxy group in this Hubble Space Telescope image has a diameter of 170,000 light years.

Above and above right, the STS-103 crew participated in a Crew Equipment Interface Test (CEIT) in KSC's Payload Hazardous Servicing Facility on Sept. 2 and 3. The CEIT gives astronauts a hands-on look at the payloads with which they will be working on orbit. STS-103 is a "call-up" mission, due to the need to replace portions of the Hubble Space Telescope pointing system, the gyros, which have begun to fail on the telescope. Although Hubble is operating normally and conducting scientific observations, only three of its six gyroscopes, which allow the telescope to point at stars, galaxies and planets, are working properly. The launch is now scheduled for Oct. 28 at 10:31 p.m.

John F. Kennedy Space Center

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