



**Condensation**

JSC Propulsion and Power Division workers are cutting space station propulsion down to size—with water. Story on Page 3.



**Homecoming**

Plans for an STS-27 welcome home celebration at Ellington Field are taking shape. Story on Page 4.

# Space News Roundup

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## Launch scrubbed; Atlantis may try again today

Launch of the Space Shuttle *Atlantis* was scrubbed at 8 a.m. Thursday because of unfavorable upper level winds at Kennedy Space Center. Launch crews immediately began working to recycle the mission for launch this morning.

Launch Director Bob Sieck said the Mission Management Team led by Robert Crippen, deputy director of NSTS Operations, would make a final decision on whether to attempt a Friday launch before loading cryogenic fuels into the external tank. That operation would have had to begin at 10 p.m. CDT Thursday.

Today's launch period begins at 5:32 a.m. CST and ends at 8:32 a.m. If a decision is made not to attempt a launch today, Sieck said, the launch could be rescheduled for Saturday. If the launch crew goes through the tanking procedures for a launch today and the launch is scrubbed, a 48-hour recycle would be necessary.

"We will wait for the most current data to make a decision," Sieck said. "If its clearly a no-go tomorrow (Friday), we don't want to put another cycle on the crew."

Larry Williams, deputy manager of the NSTS Engineering Integration



Office at JSC, said a large wind shear between the 45,000- and 50,000-foot level of the atmosphere was the reason for the scrub.

Williams said the winds aloft were blowing at 100 feet per second, and that rapid changes in both the speed and direction of the winds might have placed too much of a load on the Orbiter's wings.

Air Force Meteorologist Col. John Medura said the lower level weather was acceptable for launch at the close of the launch window. A cold front that passed through the pad area was preceded by low ceilings, rain showers and wind gusts of more than 20 miles an hour. The best lower level weather was at the end of the launch period.

Medura said today's lower level weather was not expected to be a problem at the pad, but that there was a 30-to-60-percent chance that crosswinds for a return to launch site (RTLS) landing would exceed limits today.

The chances of a crosswind violation are greater Saturday, he said.

The launch countdown for STS-27 began at 11:01 p.m. CST Sunday and proceeded smoothly. Four members of the crew—Commander Hoot Gibson, Pilot Guy Gardner and Mission Specialists Bill Shepherd and Jerry Ross—left JSC Monday to join the fifth crew member, Mission Specialist Mike Mullane, at Kennedy. Mullane had flown to Kennedy one day earlier.

STS-27 is the third flight of *Atlantis* and is dedicated to the Department of Defense. The landing time will be announced 24 hours before touchdown.



President-elect George Bush and his Mexican counterpart, Carlos Salinas de Gortari, leave the Gilruth Recreation Center flanked by Secret Service agents and reporters.

## Bush, Salinas use JSC for meeting

President-elect George Bush used JSC as a meeting ground for talks with Mexican President-elect Carlos Salinas de Gortari on Nov. 22, discussing a "wide array of issues" at the Gilruth Recreation Center.

Bush said he thanked Salinas for "coming to my home state—my home town" and wished him a successful six years in office.

"We've begun a dialogue that I think both of us want to have ongoing," Bush said outside the

Rec Center after the two-hour meeting. "I am absolutely confident after this initial visit that we are both committed to improving a bilateral relationship that is essential, in my view, as far as the United States of America is concerned."

The meeting, which featured a catered lunch of roasted Texas pheasant, Gulf Coast shrimp, chicken and sausage gumbo and chocolate truffles covered in edible gold leaf, was the first for the presidents-elect.

"It has been a positive, a respectful and a cordial dialogue which I am certain will do a great deal to improve the relations between Mexico and the United States," the Harvard-educated Salinas said through an interpreter.

Accompanying Bush were James Baker, who will be his secretary of state, Treasury Secretary Nicholas Brady and Elliott Abrams, assistant secretary of state for inter-American affairs.

## Four Shuttle crews get mission slots through early 1990

By Jeff Carr

Astronaut flight crews have been named to four shuttle missions scheduled to fly in late 1989 and early 1990, bringing the total number of crews in training to nine.

The assignments give mission slots to eight Class of '84 astronauts, eight who have not previously flown.

Air Force Col. Frederick D. Gregory will command STS-33 a DOD mission aboard *Discovery* set for Aug. 10, 1989. Gregory's five-member crew will consist of Pilot S. David Griggs and Mission Specialists F. Story Musgrave, M.D., Kathryn C. Thornton, Ph.D., and Navy Capt. Manley L. "Sonny" Carter Jr., M.D.

*Atlantis* will fly STS-34 under the command of Navy Capt. Donald E. Williams on Oct. 12, 1989. Williams and

Navy Capt. Daniel C. Brandenstein will command the STS-32 crew aboard *Columbia*. The mission, scheduled for Nov. 13, 1989, will feature deployment of the Syncom IV-5 satellite and retrieval of the Long Duration Exposure Facility. Navy Lt.

Cmdr. James D. Wetherbee will serve as pilot. Bonnie J. Dunbar, Ph.D., G. David Low, and Marsha S. Ivins have been named as mission specialists.

STS-35 will feature the ASTRO-1 astronomy laboratory and is scheduled to fly March 1, 1990. Commanding the mission aboard *Columbia* will be Navy Capt. Jon A. McBride. Air Force Col. Guy S. Gardner, has been named as pilot. Mission specialists are John M. "Mike" Lounge, Jeffrey A. Hoffman, Ph.D., and Robert A.R. Parker, Ph.D.

Payload specialist crew will deploy the planetary probe Galileo, sending it on its way to Jupiter. The pilot for the mission is Navy Cdr. Michael J. McCulley. Mission specialists will be Shannon W. Lucid, Ph.D., Ellen S. Baker, M.D., and Franklin R. Chang-Diaz, Ph.D.

ists named to the ASTRO-1 mission are Ronald A. Parise, Ph.D., and Samuel T. Durrance, Ph.D. Durrance and Parise were assigned previously to fly with ASTRO-1 in March 1986 on mission STS 61-E.

Please see **FOUR**, Page 4

## JSC spending up \$453 million; space station budget rises 67%

By James Hartsfield

JSC plans to spend a total of \$2.22 billion in fiscal year 1989, a 26 percent increase from the previous year, including a 67 percent increase in planned space station spending.

JSC's planned spending will increase by about \$453 million this fiscal year, which began Oct. 1. Spending has been boosted in all major areas. Funding for Space Station *Freedom* comprises about 14 percent of JSC's total planned costs in 1989 as compared to the 10 percent of the center's spending it comprised in fiscal year 1988, Comptroller Wayne Draper said.

"Space station spending is higher this year because of the planned buildup in development activities,"

Draper said. "That buildup is destined to grow considerably over the next several years."

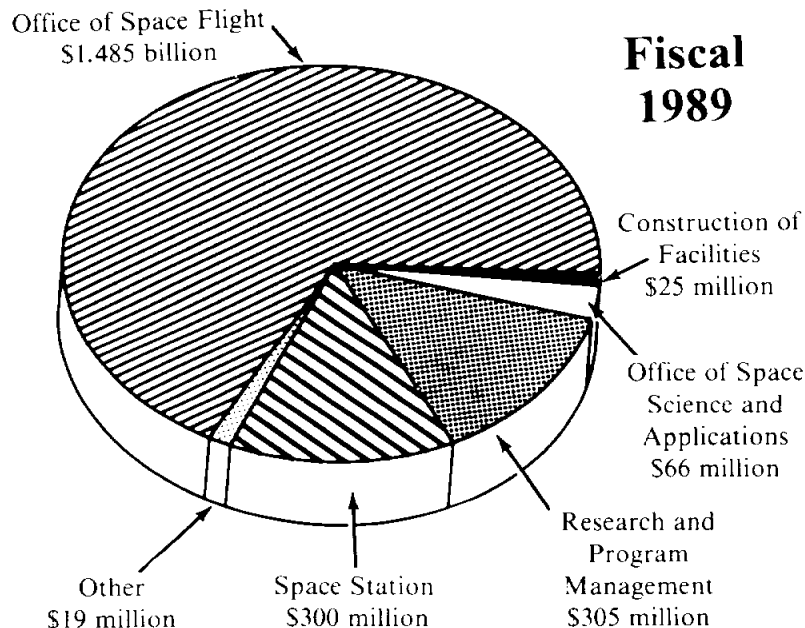
Planned spending in the Office of Space Flight at JSC, which covers Shuttle operations and flight control, amounts to about \$1.485 billion, an increase of 22 percent over last year and 68 percent of the center's total expenditures. Continued payments for the construction of a fifth Shuttle Orbiter are included in that amount and planned to cost almost \$531 million. In 1988, actual costs of the Orbiter's construction came in at \$309 million. Total Office of Space Flight costs at JSC were \$1.22 billion, or 69 percent of the total budget.

Civil service employee wages also have increased this year, largely due

to a 4.1 percent pay raise that will take effect in January 1989, and the addition of about 120 civil service positions. Employee compensation will increase from \$172.8 million in 1988 to about \$189 million. Overall, the planned costs for Research and Program Management, the area that includes civil service wages, is planned to total \$305 million, an increase of \$24 million over 1988's actual costs, Draper said.

Spending for new construction also will increase, from about \$16 million spent last year to \$25 million. The funds will go to complete the new Central Computing Facility, Bldg. 46, and to begin building a \$7.8 million, 2,000 square-foot Auxiliary Chiller

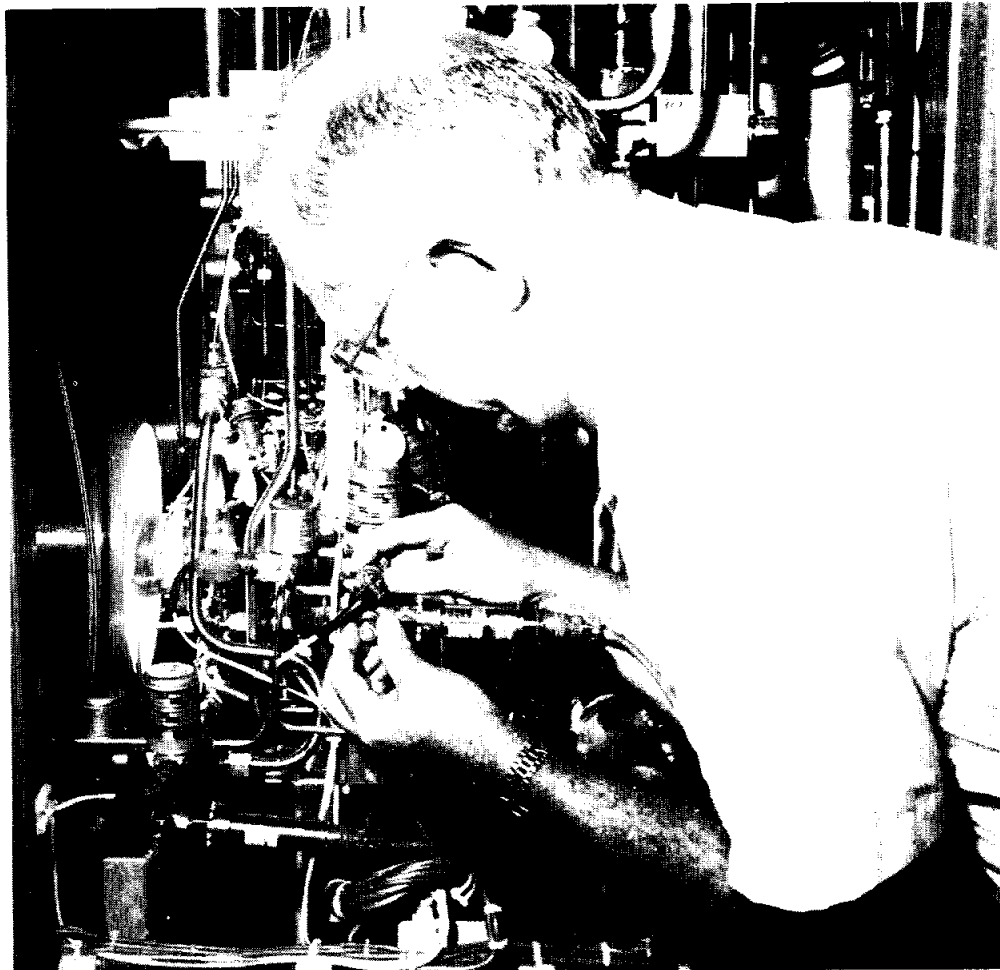
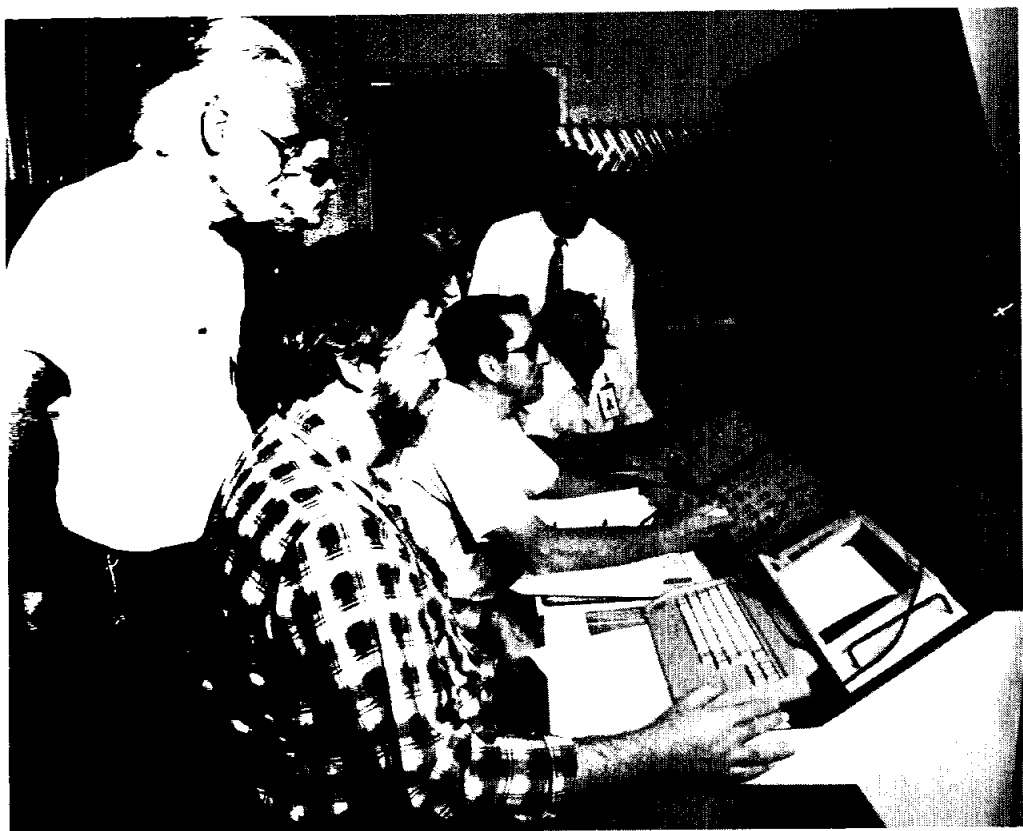
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## JSC Budget Breakdown



Below: Checking the control console for tests of a new prototype space station propulsion system are, in back, from left: Jeff O'Malley, Larry Rhodes, Larry Le and Rex Delventhal. At the controls are Jonathan Phillips, Don Stafford and Bill Michael. Right: Lockheed employee Jack Hensley makes an adjustment to the system, which will be fueled by water, near the test thruster.



# WATER POWER: Common liquid may keep space station from falling

By James Hartsfield

Although it will be a ship in a different sea, water may be the key to keeping America's space station aloft.

A team of workers in the Propulsion and Power Division at JSC is developing a propulsion system—fueled by water—that will keep Space Station *Freedom* from falling back to Earth.

A prototype of the propulsion concept, which separates water into its two components, hydrogen and oxygen, and then uses them as propellants, is now being tested in the Thermochemical Test Area. Although the test system is far different in size, appearance and construction from what eventually may fly, the processes used are identical. McDonnell Douglas eventually will build the flight hardware.

"It's an end-to-end, integrated test," said Don Blevins, assistant for program management in the division. "You put water in one end and get thrust out of the other."

A system of 24 thrusters will be needed at least four times a year to boost Space Station *Freedom* back to its proper, 220 nautical mile-high orbit, Blevins said. Using water as the raw propellant for such a system is uncharted ground, but it's an idea that makes sense.

The Shuttle uses monomethyl hydrazine and nitrogen tetroxide, two chemicals that ignite on contact, to propel it in space. But the space station's system will break down water into hydrogen and oxygen by running an electric current through it, a process known as electrolysis.

If a traditional propulsion system such as the Shuttle's were used on the space station, propellants would have to arrive by special delivery. But with a water-based system, excess water that is now dumped as waste during each

Shuttle mission can be used to refuel the station. Water is a byproduct of the Shuttle's power cells, which combine hydrogen and oxygen to create electricity, the opposite of electrolysis. The amount of water created during each flight is much more than is needed by the crew and normally is dumped overboard.

"Every time a Shuttle goes up, the excess water can be transferred to the station," Blevins said. "It's basically a free resupply that way." Waste will be eliminated.

"We can save on the amount of propellants that have to be brought up to the station," he said. "And it can save a significant amount of money over the 30-year life of the program."

The concept for the water-based thrusting system is new territory for several reasons, among them its complexity, extended lifetime and limits in weight and volume, Blevins said. JSC has the main responsibility for developing the first-of-a-kind system, and that responsibility is challenging a diverse team of workers testing the prototype in Bldg. 356.

Once the electrolyzer separates the water into hydrogen and oxygen, the two gases remain saturated with water vapor and must be dried before they can be used as propellants, said Rex Delventhal, an engineer in the Propulsion Branch. First the gases go through phase separators, cylindrical tanks that allow the heavy water vapor to sink to the bottom. Then the gases are channeled into dessiccant material dryers, dryers that work using water absorbent materials, similar to the way rice in a salt shaker protects against humidity.

The propellants are stored in tanks at a pressure of 3,000 pounds per square inch. The hydrogen and oxygen remain in gaseous form and burn as gases in the thruster, a major difference between other rocket engines that

use propellants in liquid form, Delventhal added.

Constructing such a complicated test system was a big job, Test Manager Larry Rhodes said. With the exception of the electrolyzer, a unit which was designed for a submarine and borrowed from the Navy, and the thrusters, all parts of the test system were designed, built or procured in-house by workers in the Thermochemical Test Branch, Rhodes said.

In all, about 40 people were involved at one time or another in setting up the test hardware. "It takes a lot of teamwork to pull off something like this," said Dick Bozeman, chief of the Thermochemical Test Branch. "It's new technology. We took a system that basically we knew nothing about, brought it in, put it together and made it into a working testbed. That was a real challenge." Preparations for the testing started almost two years ago.

The heart of the test system—the electrolyzer that converts water into hydrogen and oxygen—was borrowed from the Navy to keep expenses low. The unit was built by Hamilton-Standard for tests aboard submarines, said Michael Le, an engineer in the Power Branch. Le follows developments in electrolysis closely, and he located the unit.

"It was 6 years old, and reliability was a problem," Le explained. "It had undergone about 6,000 hours of testing before JSC obtained it." The electrolyzer needed extensive refurbishing before it could be used.

Another problem workers encountered was designing a regulator system that could feed hydrogen and oxygen to the thruster at a fraction of the storage pressure. The temperatures of the gases change as they are released from the tank in the same way an aerosol can cools when sprayed, and temperature affects the density of the gases. The

system must have valves that are sensitive to temperature and can regulate the flow of gas accordingly, maintaining a consistent flow to the thruster.

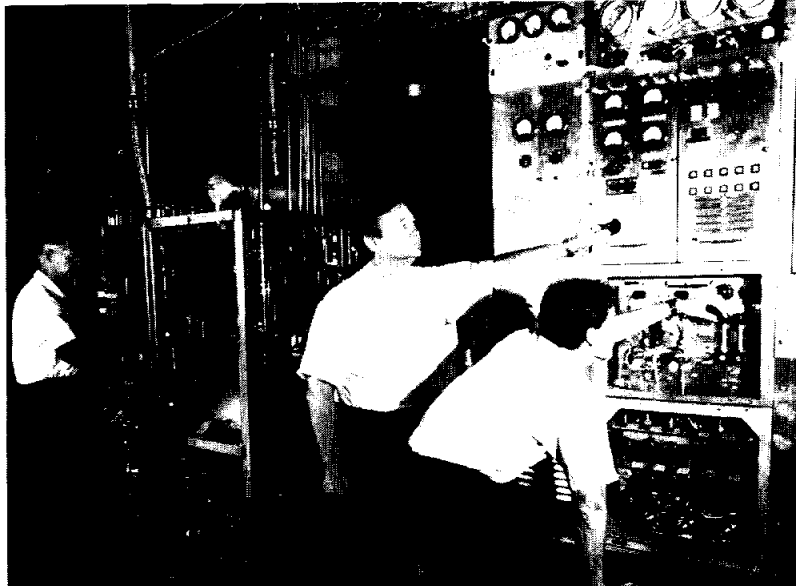
For about a month, the test system has been working well, and tests appear to be proving the feasibility of the system, Blevins said. Two thrusters will be tested on the system, one built by Bell and another by Rocketdyne. The Bell thruster has been fired seven times so far in tests, the longest of which was a 12-second burn. Next month, the Rocketdyne thruster will be tested.

Once the series of tests is completed, work will begin on a Phase B system that will more closely resemble what may fly, Blevins said. The JSC engineers plan to reduce the size of the electrolyzer unit from the Navy's four-ton, 8-foot square machine to an in-house, about two-foot square, 350-pound unit. The system also will feature storage tanks similar to the 22-inch diameter, 10-foot long cylindrical design intended for space. The future testing will involve firing two thrusters simultaneously.

When it flies, the system must be capable of firing thrusters for about a one and a half hour burn four times each year, each time boosting the space station from 10 to 15 miles higher. Without it, the station's orbit would eventually decay, and America's permanent base simply could not exist.

The thrusters need to have a functional life of about five years, Blevins said, which means at least 20 hours of use. But the system also must be capable of milliseconds-long bursts to control and stabilize the station's attitude.

"We're still refining the concept, and we're gaining confidence in it," he said. "But getting from here to what will fly will keep us thinking for a long time to come."



Left: Lockheed workers Pete Sanchez, left, and Sam Allen fine tune part of the prototype propulsion system. Center: From left, Lockheed's Jack Hensley, DeWitt Camp and Michael Sawyer work with the system, including the electrolyzer (right) which separates water into hydrogen and oxygen, the gaseous propellants. Right: Don Blevins, assistant for program management in the Propulsion and Power Division, displays a model of an electrolyzer JSC plans to develop. The smaller unit in the photo at right will perform the same job as the unit in the center photo once installed on the space station.

JSC Photos by Kim Murray



# Silver Snoopy to make comeback at JSC

The Silver Snoopy Award, a long-standing symbol of achievement presented personally by America's astronauts, will return to JSC in February.

As part of its on-going motivational activities, the Manned Flight Awareness (MFA) Program is inviting nominations for deserving JSC employees. Nominations must be submitted by Jan. 15 through each directorate's MFA Council member, who will in turn submit them to council Chairwoman Lois Walker.

The Silver Snoopy is bestowed

upon individuals from both government and industry who have performed outstanding efforts in support of NASA's manned spaceflight program. It is presented for either a single outstanding effort or for long-term, continuous outstanding performance in support of the Shuttle or payloads programs. Emphasis is placed on efforts to enhance mission success, such as design improvements, administrative, technical or production techniques, or error identification, correction and prevention that improves flight safety.

Employees eligible for Silver Snoopy recognition are those who have:

- Significantly contributed beyond their normal work output to the Shuttle/payload programs;
- Performed single specific achievements that have had significant impact on attainment of a particular Shuttle/payload goal;
- Submitted a major cost savings or a series of lesser cost savings pertaining directly to the Shuttle/payload systems or mission;
- Suggested modifications to

Shuttle/payload systems or equipment that increase safety, reliability, efficiency or performance;

- Suggested operational improvements that increase efficiency or performance; or
- Sustained superior performance over an extended period of time in support of the Shuttle/payloads program.

The award is comprised of a silver pin in the form of Snoopy garbed in a space helmet and space suit, a certificate, and a letter of commendation signed by an astronaut.



## JSC 'family' welcome home plans forming

The welcome home ceremony for the STS-27 astronauts will be a JSC "family affair" at Ellington Field, featuring collectors-item buttons for those who attend.

The 20-minute ceremony will begin about 6 hours after *Atlantis* lands at Edwards Air Force Base near the runway behind Hanger 990, the same location as the STS-26 homecoming ceremony.

NASA and contractor employees, VIPs, and the public all will be situated in the same area. Members of the news media also are expected to attend. Although the general public will not be officially invited, anyone who wishes to attend may.

The STS-27 crew return buttons, featuring the mission patch, will be distributed only to those who attend the ceremony.

The crew members and their families will be officially welcomed by Rear Adm. Richard Truly, NASA associate administrator for space flight, JSC Director Aaron Cohen, Deputy Director P.J. Weitz, NSTS Director Arnold Aldrich, and Flight Crew Operations Director Don Puddy.

The Clear Lake High School band will provide music.

The estimated starting time of the ceremony will be released as soon as 24-hour notice of the landing day and time is given. Employees who wish to attend should call the Employee Information Service, 483-6765, for a taped update of ceremony details.



**THAR' SHE BLOWS**—JSC had its own version of "Old Faithful" recently when a broken coupler for the irrigation system spewed a geyser of water behind Bldg. 2. The leak was quickly repaired by maintenance workers.

## Budget hike helps local economy

(Continued from Page 1)

Facility for the center's air conditioning system; a \$4.9 million refurbishment of the Atmospheric Reentry Materials and Structures Evaluation Facility, Bldg. 226; and to do a variety of smaller renovation and remodeling jobs.

JSC's spending in the Office of Space Science and Applications is expected to increase by \$19 million in 1989, from \$47 million in 1988 to \$66 million, a 40 percent hike.

The spending increases will boost both the space program and the local economy, Draper said. "An increase in spending generally manifests itself in increases in local contractor manpower," he explained. "And this year we'll also be able to hire an

additional 120 civil servants. That's good news for the area."

Overall, NASA was appropriated \$10.7 billion for the 1989 budget, plus an additional \$196.5 million in transfers from the Department of Defense, Draper said.

"I think the agency should feel very good about the budget it received this year. When you consider the request that was made compared with what we actually received, it's a good percentage," he said. "We're also glad Congress authorized and appropriated NASA's funding prior to the start of the fiscal year, something which hasn't occurred for a number of years. It gives us an opportunity to develop a better implementation plan for this year's budget."

## Space News Roundup

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## Four Shuttle crews get assignments

(Continued from Page 1)

### STS-32

Brandenstein, currently Chief of the Astronaut Office, has flown twice before on missions STS-8 as pilot and STS 51-G as commander. Dunbar will make her second flight as a mission specialist. Her first was on STS 61-A in October 1985. Low, born February 19, 1956 in Cleveland, OH, will also make his first flight in space. Wetherbee and Ivins will be making their first spaceflights.

### STS-33

Gregory, 47, flew previously as pilot on mission STS 51-B in May 1985. Griggs, 49, flew as a mission specialist on STS 51-D in April 1985. Musgrave, 53, has flown twice before as a mission specialist on STS-6 in April 1983 and again on STS 51-F

in July 1985. Carter, 41, and Thronton, 36, will be making their first flights.

### STS-34

Williams, 46, was pilot on STS 51-D, the fourth flight of *Discovery*, in April 1985. Chang-Diaz, 38, was a mission specialist on STS 61-C in January 1986 aboard *Columbia*. Lucid, 45, flew as a mission specialist on the fifth flight of *Discovery*, STS 51-G, in June 1985. The flight will be the first for McCulley, 45, and Baker, 35.

### STS-35

McBride, 45, previously flew as the pilot of STS 41-G aboard *Challenger* in October 1984. Gardner, 40, scheduled to fly STS-27 aboard *Atlantis*, will be making his second flight. Hoffman, 44, also making his second Shuttle flight, was a mission specialist on STS 51-D aboard *Discovery* in

April 1985. Lounge, 42, will be making his third spaceflight as a mission specialist. He has flown on *Discovery* missions STS 51-I launched in August 1985 and STS-26 launched in September 1988. Parker, 51, making his second Shuttle flight, was a mission specialist on the first Spacelab mission, STS-9, launched in November 1983. Durrance, 45, is a scientist at The Johns Hopkins University in Baltimore, with experience in ultraviolet studies of solar system objects through satellites and sounding rockets. Parise, 37, is an employee of Computer Sciences Corp., Silver Spring, Md., who has been involved in flight instrument operations development and research on binary star systems. The ASTRO-1 payload specialists will be making their first trips to space.

## More employees give larger donations as CFC comes to close

JSC employees gave in greater numbers and with more generosity this year in the Combined Federal Campaign (CFC), eclipsing last year's participation and donations.

JSC raised 98.6 percent of its goal in the 1988 CFC, donating a total of \$261,420. The figure outpaces 1987's total of \$237,301. The number of employees participating in the fund drive increased as well this year to 88 percent of all JSC civil service and military workers. Last year, 77 percent of all workers participated.

As a result of employees' generosity, JSC received the CFC Chairmen's Division Award this year, an award presented to organizations that exceed a quarter of a million dollars in donations, said Teresa Sullivan, JSC's coordinator for the 1988 CFC.

"On behalf of the Gulf Coast CFC, I'd like to thank all the employees who

gave and the JSC retirees who went out of their way to give this year," Sullivan said. "I think it's great. It's another indication that JSC employees want to contribute to the community."

The Houston-wide CFC has not yet been completed because some organizations began their drives later than did JSC. It will continue through December, she said.

At JSC, nine areas surpassed their fund-raising goals, with the highest giving more than 186 percent of its target. Not only did more employees participate, they gave more generously, Sullivan said.

Although the JSC campaign officially ended Nov. 18, it's not too late to give. Those who wish to donate now should contact Sullivan or Mary O'Connell in the JSC Exchange Operations Office at x39168.

## New flagpoles to fly Texas, NASA banners

JSC's flags—banners of the United States, Texas and NASA—will be flying high following the launch of STS-27 thanks to three new flagpoles recently installed in front of Bldg. 1.

The new flagpoles were planted farther away from Bldg. 1 than JSC's previous single flagpole to avoid turbulent winds that had created problems in the past, Center Operations Director Ken Gilbreath said. The single flagpole had been used to fly the U.S. flag, and, at times, to fly the NASA flag below it during flights. The Texas flag also had been flown below the U.S. flag on special occasions, such as Texas Independence Day, Gilbreath said.

"The original location of the flagpole was so close to Bldg. 1 that the flag just didn't fly right," he said. "And for a long time, many people have had the desire for us to fly several flags simultaneously. It all does much better now."

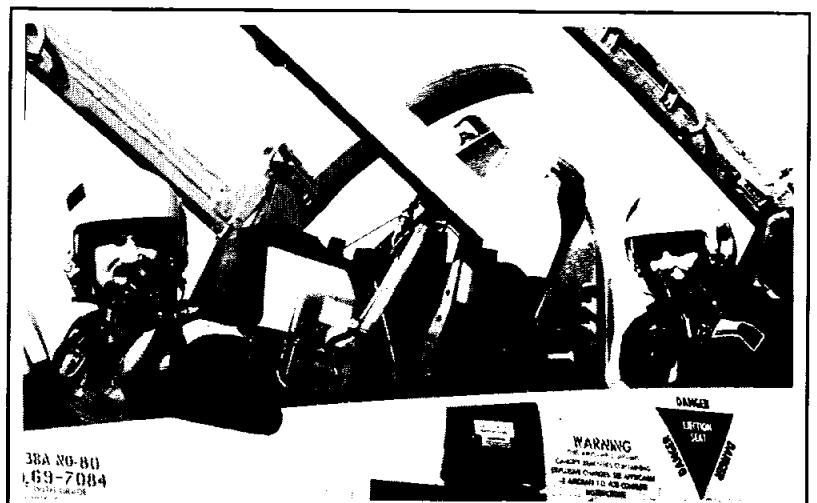
Now, the NASA and Texas flags will be raised alongside the U.S. flag on the morning of STS-27's launch. "Whenever we're in orbit, they'll remain

up 24 hours a day," Gilbreath said. Lights for the flagpoles have been relocated, and at night during missions the three will be illuminated. When NASA isn't in flight, the three flags will be flown daily for the same period now used for the U.S. flag—hoisted at sunrise and lowered at sunset.

Other normal routines at JSC also will be altered during STS-27 to better serve employees working special hours in support of the mission. The Bldg. 11 cafeteria will open early, at 6 a.m., on weekdays and close at 2 p.m. On weekends, the Bldg. 3 cafeteria will open at 6 a.m. daily and close at 4:30 p.m.

The Gate 4 entrance to JSC from Space Center Blvd. will remain open 24 hours a day during the mission. Gate 1, the primary entrance off of NASA Road 1, also will be open around the clock as usual. Other gates will operate during normal business hours.

Employees entering or exiting the center after dark are asked to turn off their cars' headlights as they approach a guardhouse.



**CAPE BOUND**—STS-27 Pilot Guy Gardner, left, and Mission Specialist Jerry Ross strap into a T-38 at Ellington Field in preparation for their pre-launch flight to Kennedy Space Center. The crew, except for Mike Mullane who flew to the Cape on Sunday, left JSC on Monday.