



Space News Roundup

Vol. 27

July 29, 1988

No. 20

Engineers mount offensive on leak; FRF set Monday

Creativity met with technology during the past week as engineers searched for an answer to the leak that could keep *Discovery* on the ground for up to two more months.

While repair proposals continue to be reviewed, pre-flight work has forged ahead with the completion of the Wet Countdown Demonstration Test and preparations for the Flight Readiness Firing (FRF) now set for Monday.

Since the time the nitrogen tetroxide leak in the Reaction Control System (RCS) of the left Orbital Maneuvering

System Pod was detected by launch pad technicians, engineers have been investigating a number of responses.

"We're still looking at several different materials," said Chester Vaughan, chief of the propulsion and power division of the Engineering Directorate. "I think we've identified two or three fixes that we have determined are technically feasible. Now the question is which are the better ones to implement in this situation."

No final decision about fixing the

leak will be made until after the FRF.

The leak is in a half-inch diameter dynatube fitting on the overflow line above the RCS oxidizer tank. The line allows technicians to determine when the tank is full. The line is closed and not used during flight. The dynatube is about 6 feet away from the nearest access port.

Stopping the leak on the pad could be done by one of two basic access methods — from inside the line or from outside it. Vaughan said a plug could be inserted into the line and worked

into place either with pressure or with a snaking device.

"A few days ago we were not sure we could do that technically," he said. "We now believe we can, particularly with pressure. We can get a plug up there and plug the line upstream of the dynatube, between it and the tank."

Or, the leak could be fixed by cutting through the shuttle's bulkhead and using a "clamshell" device injected with some type of sealant outside of the line.

"We have demonstrated that we

could do that," Vaughan said. "That's technically feasible also. The only issue still open on that approach is to make sure the materials have a long-term compatibility with the oxidizer."

Since repairs have been deemed technically possible, officials are now looking at other factors that will come into play when fixing the leak. To plug the lines, technicians may need to cool the oxidizer from its boiling point or may need to empty the oxidizer tank.

Please see **SEARCH**, Page 4

Turning light into sound

Infrared communications to fly aboard Discovery

By James Hartsfield

For Joseph Prather, light and sound have become one in the same.

Prather has been working to merge the two since his first days at JSC as a cooperative education student, and the benefits of his efforts are as bright as his light is invisible. Prather is the father of the Infrared Communications Flight Experiment that will fly aboard *Discovery* on STS-26.

Prather's device uses infrared light, rather than radio waves, to transmit sound. It eventually may be used as an on-board crew communications system on Orbiters and *Space Station Freedom*. An infrared system could be superior to the wireless individual radios now used by crewmembers to communicate, said Prather, an aerospace telecommunications technologist in the Tracking Techniques Branch.

"I think it's clearer than RF (radio frequency) units. There's less interference," he said. "The world is very noisy RF-wise: A refrigerator can even generate RF interference. And there are so many RF users that the frequency you can use is very limited; the bandwidth is all used up."

Prather's is the most advanced two-way infrared light communication system in the world, and he's been developing it since he first worked at JSC in 1981 while a student at the University of Washington in Seattle. He was assigned to explore the possibilities infrared communications offered and worked on the project through three terms as a co-op.

Prather received his degree in electrical engineering in December 1984, and he began working fulltime at JSC a month later. When he began his work on infrared communications, no two-way systems existed.

"There were a lot of one-way links, including one in Jones Hall in Houston. Jones Hall had a large infrared transmitter above the stage that sent signals to receivers used by the hard of hearing," he explained. "All they had was a simplex system, but we needed a duplex system."

With the help of Lockheed engineers Barry Booker

Please see **INFRARED**, Page 4



JSC Photo by Sheri Dunnette

Aerospace Communications Technologist Joseph Prather has worked on communications using infrared light, rather than radio waves, since he started at JSC as a cooperative education student in 1981. The result, the Infrared Communications Flight Experiment (IRCFE), will fly on STS-26.

Computer helps track STS status

By Kelly Humphries

NASA's agencywide Program Compliance and Status System (PCASS) will have a new home in about a month when a new computer arrives at JSC to help pull together the many separate problem tracking data bases set up by NASA and its contractors.

The new computer, an IBM 3081-KX6, will provide the computing power needed to make the central repository for critical National Space Transportation System (NSTS) information faster and more user friendly. It is expected to arrive at Off-site Computer Facility-1 this week, and be put into operation Aug. 6 and 7.

Bob Moorehead, manager of the NSTS Engineering Integration Office, said the new computer is merely a tool to facilitate communication throughout the Space Shuttle program and support program-level checks and balances.

"PCASS is important in that it provides access to data and information around the program so that we can support the systems integration function," he said. "It lashes the program together."

Ron West, manager of the Data Integration Office, said the system will provide for the first time automated, closed-loop configuration accounting for both flight hardware and maintenance requirements.

PCASS was created in response to recommendations of the Rogers Commission following the *Challenger* accident. It is designed to help ensure that problems such as the one that

Please see **COMPUTER**, Page 4

First Space Station test hardware arrives at JSC

JSC received the first shipment of Space Station test hardware Monday, a mockup of an airlock for use in the Weightless Environment Training Facility (WETF) built by McDonnell Douglas Astronautics Company.

The delivery includes mockups of the two compartments planned for Space Station airlocks, an equipment lock and a crew lock. The equipment lock will be used to house, service and dress in spacesuits while the crew lock will be an area that can be depressurized to match the vacuum of space. Both compartments will be large enough to accommodate two crewmembers.

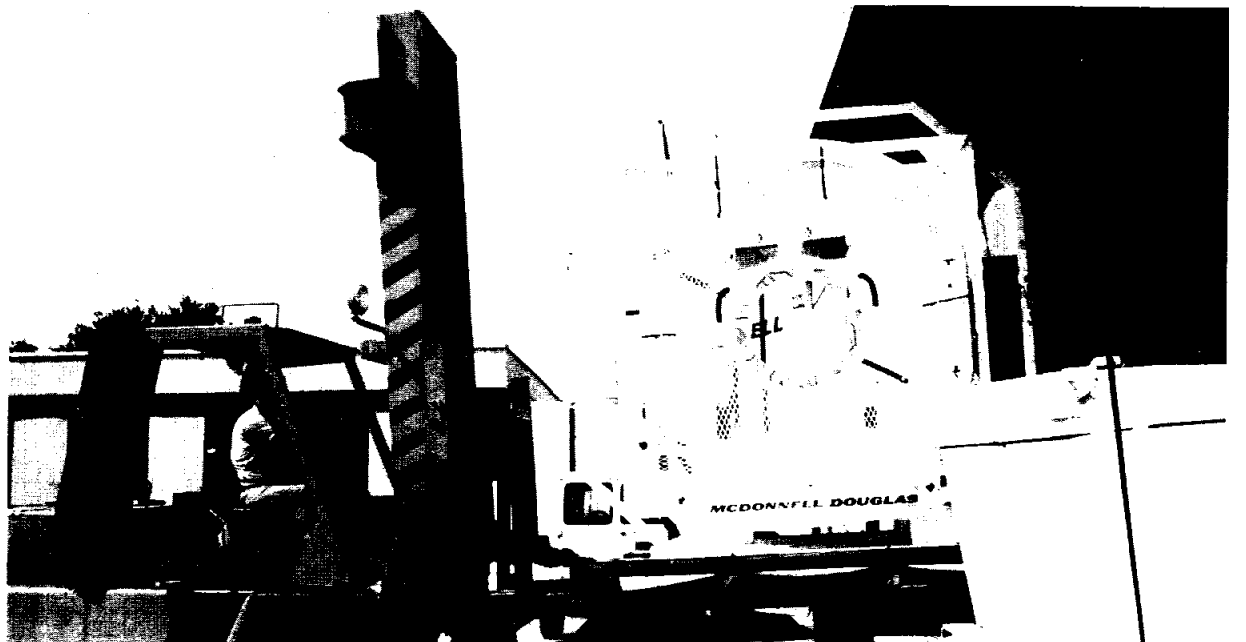
A rough version of a Space Station extravehicular activity (EVA) is being enacted under water in the WETF this week using the new mockup. Astronauts don spacesuits and conduct a series of tests with the two compart-

ments of the airlock, and the two compartments are gradually being expanded from their smallest configuration to determine the most suitable volume for pre- and post-EVA work.

The correct sizing of airlocks is critical to allow the astronauts to enter and exit the Space Station in the most efficient way during assembly and maintenance of the Station itself and maintenance or repair of experiments and satellites.

The volume of the interior will determine the amount of power, crew time and expendables required to pressurize and depressurize the airlock.

The ultimate goal of the tests is to determine the smallest volume possible for each of the two compartments of the airlocks consistent with the work that must be done inside them.



JSC Photo

AIRLOCK MOCKUP — The first shipment of Space Station test hardware from McDonnell Douglas is unloaded at JSC Monday. The two-compartment, adjustable airlock mockup will be used in the WETF to determine the most feasible size for the actual Space Station airlocks.

Keeping track of HISTORY



JSC Photos by Benny Benevides

Above: Joey Pellarin, left, associate librarian in the History Office, and Janet Kovacevich, lead librarian, help researcher Roger Bilstein find material about the early days of JSC. Left: Asha Vashi, data processor for the History Office, pulls some of the thousands of files stored in the office, located in Bldg. 420, Rm. 105, to check their indexing.

From cow pastures to Moon landings, History Office follows JSC

By Kari Fluegel

Deep within the boxes lining the shelves of Room 105 in Bldg. 420 lies the story of a space program — from its inception 30 years ago today and the creation of a space center on a South Texas cattle field to the triumph of a leap for mankind and the tragedy of a lost crew.

The papers and documents filling the boxes in the JSC History Office not only tell the past of America's space program, they are that past.

"I view this office as the memory of JSC," said Janet Kovacevich, lead librarian in the History Office.

The office, organized in the early days of JSC, collects all types of non-record documents used in building the U.S. manned space program.

NASA was created July 29, 1958, when President Dwight D. Eisenhower signed the National Aeronautics and Space Act. The act formed the civilian space agency from the National Advisory Committee for Aeronautics.

Besides having a copy of the act that launched the manned space program, the History Office contains hundreds of items about the Mercury, Gemini, Apollo, Apollo-Soyuz, Skylab, Space Shuttle and Space Station projects.

"We can actually look at the space program as it unfolded," Kovacevich said. "How did they make the design decisions for Shuttle — who made them, at what level were they made and what were the things that were driving the design decisions."

"It's particularly wonderful because so much of it is JSC's efforts — JSC's special mission to send men into space," added Joey Pellarin, associate librarian.

Working with items such as engineer Bill Petynia's early Shuttle orbiter designs, the Apollo 13 flight directors' handwritten mission notes and engineer Andre Meyer's

post-Apollo planning notes gives one a feeling for the atmosphere that existed as it evolved, Kovacevich said.

"The Shuttle is big business," she said. "Mercury was a bunch of guys trying to get something off the ground. In this office you get the whole picture. You've got to be awestruck—we sent men to the Moon."

The History Office exists to help keep the awe of NASA's accomplishments alive.

"You can't work in this place and not get an incredible appreciation of the space program," Kovacevich said. "These papers are not dead. You look at them and this place just starts to pulsate."

Items available in the History Office include memos, design specifications, manuals, contractor reports, Congressional reports, astronaut biographies, oral histories, copies of The Space News Roundup, JSC management announcements, telephone directories, air-to-ground transcripts, some flight data files and news clips.

"JSC's special mission to send men into space is chronicled here," Pellarin said.

The numerous files on Shuttle, Space Station and the history of JSC can be obtained in Bldg. 420, but NASA-owned files on the Mercury, Gemini, Skylab and Apollo-Soyuz programs available through the History Office are stored at Rice University. Apollo files are in the process of being transported to Rice following the recent completion of a reference book about the program.

"I have enriched my knowledge about the space program a lot, which could not have been possible otherwise," said Asha Vashi, data processor. "I am proud to be part of the team."

The History Office is available only to researchers with clearly stated research objectives,

Kovacevich said. Policy for the office defines such researchers as internal NASA civil service and contract personnel working on job related research; NASA contract historian and history grantees; current and past NASA employees and current contract representatives researching history projects; and academic students of history with a clearly stated research objective and university affiliation.

"We really want to protect this collection," Pellarin said. "This is really the only collection of its kind. There's nothing anywhere that matches it."

'These papers are not dead. You look at them and this place just starts to pulsate.'

**—Janet Kovacevich
History Office
librarian**

JSC is the only NASA field center that has a large, organized collection of documents that contains the story of space programs past.

"One of the reasons is that very early in the history of Johnson, there was an historian appointed. We've got a history of having someone involved in that kind of work," said Don Hess, office coordinator.

The JSC collection has been used for a number of research

efforts. Author Tom Wolfe garnered much of his information for *The Right Stuff* from JSC files. Contractors doing research for the Crew Emergency Return Vehicle for Space Station also have enlisted the office's help.

"We here in the History Office are not going to design the escape system or design the rockets, but we are going to help people remember how it was done in the past so they can design effectively for the future," Pellarin said.

"We all have a feeling this is really important stuff out here," Kovacevich explained. "Because people, especially engineers, are very forward-looking individuals, they don't often realize the value of all their old stuff. Engineers are working on a project right now. They realize the value of old papers when they have to go back to a problem, look at the documentation and it's there. We're kind of keepers of the past."

Books written in the History Office include *This New Ocean: The History of Project Mercury*; *On the Shoulders of Titans: The History of Project Gemini*; *Stages to Saturn: A Technological History of the Apollo Saturn Launch Vehicle*; *Chariots for Apollo: The History of the Manned Lunar Spacecraft*; and *The Partnership: The History of the Apollo-Soyuz Test Project*.

Work will begin next month on a new book about JSC history.

"The difference in the JSC history project and others we've done is that this will be written with a focus on the infrastructure that was necessary to get the job done and the relationship between the center and headquarters, the center and the community, the center and its own people, and the center and other centers," Hess said.

"The intent is to focus on the people who did it and how they did it, rather than what we did."

Hess also said the concept is to publish a book "somewhere

between a technical publication designed for an engineer and *The Right Stuff*."

"Ideally, the man on the street could pick it up, read it, enjoy it and understand it, and, by the same token, there would be something for someone involved in the program."

Those associated with the History Office welcome researchers.

"These are really working files," Pellarin explained. "They're not meant to be dust-covered museum pieces some dottering professor alone will look at 20 years from now. They are meant to be working, helpful files for engineers, managers, academic people and independent authors to actively use and inspire a vibrant research interest in manned space flight."

Kovacevich said people walking away from the History Office should have the information they need or should know where to get it. Following the *Challenger* accident, NASA officials received what they needed almost immediately.

"After 51-L we had a request in this office for information on the Apollo 1 fire and how they handled that investigation," she said. "Within hours we had all that information over to Bldg. 1 because the information was so accessible."

Such availability of historical records is vital, Pellarin said.

"NASA was under such intense scrutiny at that time, it had to really scramble for that information, had to be ready to start work immediately and had to establish the investigation board effectively from the start," she said. "I think NASA officials realized at that point what a valuable asset this office is."

Since 51-L, research activity in the History Office has increased 200 percent. In 1987 alone, it increased 40 percent.

"We want people to know we're here," Kovacevich said. "We want them to use the files. We want people to realize that we have what they're looking for."

Search goes on for leak repair

(Continued from Page 1)

Before cutting through the bulkhead, engineers must be sure they are able repair the incision.

"It's those kinds of things we are laying out to see how much time it would take and how much risk is involved in each," Vaughan said. "Obviously we'd like to do it in as risk-free manner as possible and in one that affects the system the least amount."

Engineers have not yet ruled out flying *Discovery* with the leak as is. The leak is so small that it would take 60 to 90 days before a same size hole on a car tire would result in a flat.

"The FRF will give us a lot of information," Vaughan said. "If the leak gets worse during the FRF, I don't think we would consider flying as is. The main concern with flying as is is can you guarantee it won't get worse."

Vaughan said he is not yet speculating on the amount of time it would take to fix the leak on the pad.

"We've been concentrating more heavily on being sure that with the various options you can do the job, technically."

A number of other variations have been introduced and researched, including one in which the clamshell would vent the leak to any area less significant to the Shuttle hardware.

The team effort by JSC, Kennedy Space Center, Marshall Space Flight Center and various contractors has been phenomenal.

"A week ago last Saturday, we didn't know where the leak was located," Vaughan said.

"We've had a lot of the people at the center helping us. We did some work in the test area this past weekend. We had support from the closed circuit TV people. We've got tech services helping us making the clamshells and those kinds of things. We also have procurements helping us get some contracts from some local firms who have the capability and ability to pump material to stop the leak. There's been a lot of good teamwork."

While one team works to solve the shuttle's leak problem, another is preparing for the 22-second test of *Discovery's* main engines currently set for 6:30 CDT Monday at Kennedy. The FRF, previously scheduled for Thursday, was postponed by problems arising during the wet countdown test.

The wet countdown first went into an unplanned hold Monday afternoon when officials determined an additional day was needed to complete the necessary work prior to loading liquid oxygen and liquid hydrogen into the power reactant storage and distribution system tanks.

Then, Wednesday afternoon, a few problems, including changing a valve in the liquid oxygen side of the Orbiter Midbody Umbilical Unit, arose.

The wet countdown clock started again at 10 a.m. CDT Thursday.

Infrared communications may find variety of uses

(Continued from Page 1)

and Alan Barbee, among others, a two-way system took shape. An experimental version was scheduled to fly on the Shuttle in 1986, but then flights were suspended.

"It was emerging technology then, but now it's much more mature," Prather explained. "The stand-down has given us a chance to do some modifications and make it a better system. The only thing keeping it from being operational now is the flight testing."

STS-26 Mission Specialist Pinky Nelson will operate the Infrared Communications Flight Experiment (IRCFE) aboard *Discovery*, wearing a belt dotted with three infrared light emitting diode modules, which broadcast signals, and three photo diode modules, which receive signals. The lightweight portable transceiver and headset are exactly the same size as the interim wireless crew communications system, the system first used aboard the Orbiter.

Mounted in *Discovery* will be three pairs of transmitter/receivers, one pair on the aft middeck wall and two pairs on the flight deck walls. Nelson will broadcast with the system from all areas of the Orbiter to check for interference, and he may make some air-to-ground calls from the infrared unit. "About the only variable you have in space which we don't have in the lab is the different configurations a crewmember can get into in zero-G," Prather said. The two-hour experiment will be conducted during a non-critical part of the mission, and Prather is confident his system will work well.

"If the crew likes the voice quality and coverage, they can use the system through the rest of the mission," he said. "And I think they might take that option."

Infrared communication has many advantages over radio. The unit uses less power and can be made smaller, thus less intrusive on crewmembers, and infrared light interferes less with many experiments, Prather said. But space flight won't be the only benefactor from the technology.

Many spin-offs may come from the two-way infrared communications work at JSC, and it is receiving the attention and funding of NASA's Technology Utilization Program. The



STS-26 Mission Specialist Pinky Nelson checks out the Infrared Communications Flight Experiment during training in Bldg. 9A.

medical field is particularly interested, and has been for more than three years. Infrared communication could do away with the wires now required by electrodes used to monitor the body's vital signs, a real benefit in the cramped, crowded areas of operating rooms, ambulances and Life Flight helicopters.

Infrared control of robots also may be useful, allowing commands to be sent with less interference, and engineers are studying the possibility of sending telemetry from the end of the Orbiter's manipulator arm via infrared light. In the future, infrared lasers may even be used for deep space communications.

The next step, already developing, is to refine infrared communications into a 24-channel system for use aboard Space Station *Freedom*.

For Prather, communications via light are the way of the future.

"Both radio frequencies and light have their place. But you're going to see optics used more and more," he said. "If you look at fiber optics, a few years ago it wasn't much. But now it's really taken off. It's amazing."



JSC Photo

Gary Gibson, Clear Lake Amateur Radio Club member, communicates with other enthusiasts throughout the world during a recent field day exercise.

Ham radio buffs hold field day

By Marie Simon

Special to the Roundup

From Morse code to satellites, JSC ham radio operators used the full spectrum of communication devices recently to contact more than 1,500 stations across the United States, Hawaii and Japan.

Field Day 1988, hosted by the JSC Amateur Radio Club, the Clear Lake Amateur Radio Club and the Bay Area Amateur Radio Club, took place under the oak trees at the Gilruth Recreation Center June 24-26. The exercise was a 24-hour long contest where more than 50 ham operators attempted to make as many contacts with other radio stations as possible.

Participants moved their equipment from its normal station to a "remote" place, but rain on the first day kept the operators from making much progress.

The field day began Saturday morning as antennas were installed, a tower erected and radio equipment set up.

Lou McFadin provided a grid

computer that was automated for antenna pointing and satellite tracking. "The majority of the contacts were made through the Amsat Oscar-10 satellite which is in a high altitude elliptical orbit," satellite operator Gil Carman said.

At an altitude of 20,000 miles, the satellite was sending weak signals and contacts were difficult, Carman said. But as it descended in its orbit, conditions improved. Nearly 36 contacts were made via satellite with other field day stations across the nation, including Hawaii. The Japanese Fuji Oscar-12 satellite was responsible for a few contacts JSC operators made with Japan. But communication was cut short when the Japanese disconnected their transponder in order to recharge the batteries, drained because of the continuous field day operations, Carman said.

Ham radio operator Gerry Creager said the field day has evolved during its 50-year history into a contest "to make emergency simulation more interesting." With

commercial power and electricity unavailable, operators used "battery or human-generated power," said Creager, "for a number of different modes of communication."

Harvey Vordenbaum, another operator, pointed out that "equipment and techniques have evolved to the point where a number of exotic modes such as digital, video, relay satellites and voice are used in addition to Morse code—the old stand-by."

Amateurs received bonus points for each of the different kinds of communication they used. Despite the threatening weather, Vordenbaum said, between 1,500 and 2,000 contacts were made.

During times of emergency, disaster relief centers for Seabrook, Taylor Lake Village, El Lago, Nassau Bay, Webster and the Clear Lake area are kept in touch by ham radio operators. In crisis circumstances, the amateurs have been known to set up in a matter of minutes.

Bldg. 1 snack bar opens Monday

Aromas of fresh coffee, popcorn and hot dogs will soon drift through Bldg. 1 as a change is made in the first floor snack room.

Operation of the Bldg. 1 snack room will be handed over to Tom Townsend, who will run a concession stand where JSC personnel and visitors can purchase coffee, tea, doughnuts, hot dogs, popcorn and yogurt, as well as maintain the current vending machines.

Townsend, 29, is blind and has been using a cane since 1981.

The new concession area in Room

142 is being opened under the Randolph-Sheppard Act of 1974 in cooperation with the Texas Commission for the Blind.

Townsend has worked at vending and cafeteria locations at the Federal Building in Houston in 1981, the Supreme Court Building in Austin from 1982 to 1986, and at General Dynamics in Abilene from 1986 to 1988.

The JSC concession, which opens Monday, will have vending machines as well as over-the-counter items. The machines will be accessible 24

hours a day, while Townsend's concession will operate from 7 a.m. to 3 p.m.

The Bldg. 1 operation will be the first of its kind at JSC, said Teresa Sullivan, manager of exchange operations.

"I think it's going to continue the personal service and add some new items for building occupants and visitors," Sullivan said.

Townsend is a native Texan born in Waxahachie. His hobbies are water sports, fishing, playing the guitar and reading. He also enjoys people.

Computer holds STS program status data

(Continued from Page 1)

caused the loss of *Challenger* are consistently recorded, tracked and corrected.

In spite of a computer processing crunch, PCASS is nearly complete thanks to an innovative loan worked out with the Mission Support Directorate's Data Processing Support Division (DPSD). DPSD also has helped link PCASS with all of the other Shuttle facilities around the country through a computer network. The network links more than 100 significant Shuttle data bases.

For example, Moorehead said, if a hardware problem were reported at Kennedy Space Center today, his office would immediately have a record of the problem and be able to track its status through the failure analysis, troubleshooting and repair process wherever those activities took place.

"We haven't had that sort of capability in the program before," he explained. "The system up until

51-L lacked the discipline it should have had. There was no single authoritative source to determine if all the prescribed work had been completed.

PCASS originally was housed on the Integrated Management Information Computer (IMIC) operated by STSOC. But by November 1987, it had become clear that the program would soon outgrow the IMIC.

Johnny Cools, DPSD deputy chief, said the division was able to loan the Center Information System-C (CIS-C) to the Space Shuttle Program Office until it could procure a larger machine. In April, the entire CIS-C workload was transferred to the larger-capacity CIS-D computer. The added power of CIS-C allowed the building of PCASS to continue.

The task of preparing and migrating the programs and data from CIS-C to CIS-D was large and complicated, but the actual transfer took just one weekend. Several planned outages occurred, but the disruptions were

scheduled during non-prime working hours to minimize the strain on users.

"The effort they put out was really outstanding and well coordinated," West said.

Space News Roundup

The Roundup is an official publication of the National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Texas, and is published every Friday by the Public Affairs Office for all space center employees.

Editor Kelly Humphries

Asst. Editor . . . James Hartsfield