

NASA exercises X-34 contract option to add 25 test flights

X-34 to test-fly at White Sands and Kennedy Space Center beginning in early 2000

NASA has exercised an option in its X-34 contract with Orbital Sciences Corp., Dulles, Va., for 25 additional test flights during a 12-month period beginning immediately after the initial contract is complete. The option is valued at more than \$10 million, with government organizations performing an additional \$4.7 million in work.

By exercising the flight test option for X-34, NASA has initiated a detailed flight test planning process with Orbital Sciences Corporation to define specifics for each mission in the X-34 flight test program. One of the key aspects of this planning process will be establishing acceptable agreements between the NASA/Orbital team and the ranges where the flights will be conducted for both safe and cost-effective operations. The X-34 is under the Space Transportation Programs Office at Marshall and intended to dramatically reduce the cost of access to space.

Flights under the option are planned to be conducted initially at
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Bob Schwinghamer retires after more than 40 years of service

by Mike Wright

Bob Schwinghamer knows precisely how to put together an engineering design tree that will pinpoint every intricate step involved in building or operating some of the most complex space hardware systems in the world.

So it's no wonder that he can pinpoint the exact circumstances that triggered his interest in a life-long career in space and rocketry, a career that he officially concluded with his retirement a few days ago.

Schwinghamer retired as Marshall Center's Associate Director Technical after completing more than 40 years of service to the U.S. Army and the NASA Marshall Center.

"It all started about 1947," said Schwinghamer, who earned his engineering degree at Purdue in the years after World War II. "I saw a Time magazine with a rocket on the cover. It was a V-2 rocket with an upper stage attached to it. I read about that, and I thought boy, that's really fascinating. I was taking thermodynamics at the time. So I had had some exposure to rockets at Purdue. But that

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NASA photo

Tom DeLay, a Marshall materials processes engineer, uses a new graphite epoxy technology to create lightweight cryogenic fuel lines.

Affordable space access

Advanced technology will make future space vehicles lighter and cheaper

by Joy Carter

To greatly reduce the cost of getting to space, engineers at the Marshall Center are working with industry partners to develop a new generation of space vehicles.

Lightweight composite fuel tanks and components under development are critical elements of tomorrow's Reusable Launch Vehicles.

Marshall materials processes engineers are using a new graphite epoxy technology to create lightweight cryogenic fuel lines for vehicles such as the X-33 Advanced Technology Demonstrator.

Engineers wrap a water-soluble mandrel — or mold — with a graphite fabric coated with an epoxy resin. Once wrapped, the pipe will be vacuum-bagged and autoclave cured. The disposable mold will be removed, leaving a thin-walled fuel line.

The material is much lighter and stronger than metal and won't expand or contract as much in the extreme temperatures launch vehicles encounter.

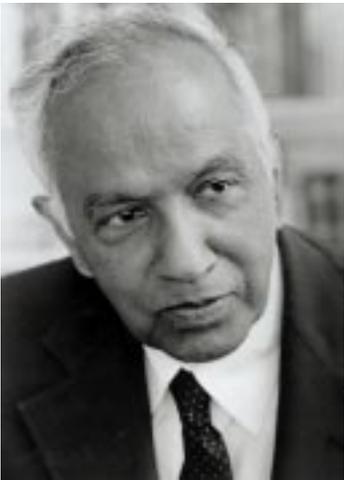
X-Ray Observatory renamed; launch scheduled for April

by John Bryk

NASA set a new launch date for the Advanced X-ray Astrophysics Facility, and announced that it will be renamed the Chandra X-ray Observatory in honor of the late Indian-American Nobel Laureate Subrahmanyan Chandrasekhar.

The Marshall Center manages the Chandra X-ray Observatory program for NASA's Office of Space Science, Washington, D.C. The Smithsonian Astrophysical Observatory controls science and flight operations of the observatory for NASA from Cambridge, Mass.

The Chandra X-ray Observatory will be shipped to the Kennedy Space Center, Fla., on or before Jan. 28 and launched no earlier than April 8, 1999. The launch date will be subject to



Subrahmanyan Chandrasekhar

the actual shipping date and the results of a mid-February independent review of the progress toward preparing the operations center in Cambridge, Mass., for launch.

Chandra will be carried to space aboard the Space Shuttle Columbia on mission STS-93, commanded by astronaut Eileen Collins. The shipment of the spacecraft was delayed in mid-October so the prime contractor, TRW Space and Electronics Group, Redondo Beach, Calif., could complete testing on flight software.

"Chandra," a shortened version of Chandrasekhar's name, which he preferred among friends and colleagues, was chosen in a contest to rename the X-ray telescope. "Chandra" also means "Moon" or "luminous" in Sanskrit. The winners are a high school student in Laclede, Idaho, and a teacher in Camarillo, Calif.

"Chandrasekhar made fundamental contributions to the theory of black holes and other phenomena that the Chandra X-ray Observatory will study. His life and work exemplify the excellence that we can hope to achieve with this great observatory," said NASA Administrator Dan Goldin.

"Chandra probably thought longer and deeper about our universe than anyone since Einstein," said Martin Rees, Great Britain's Astronomer Royal.

Chandrasekhar, widely regarded as one of the foremost astrophysicists of the 20th century, won the Nobel Prize in 1983 for his theoretical studies of physical processes important to the structure and evolution of stars. He and his wife emigrated from India to the United States in 1935. He served on the faculty of

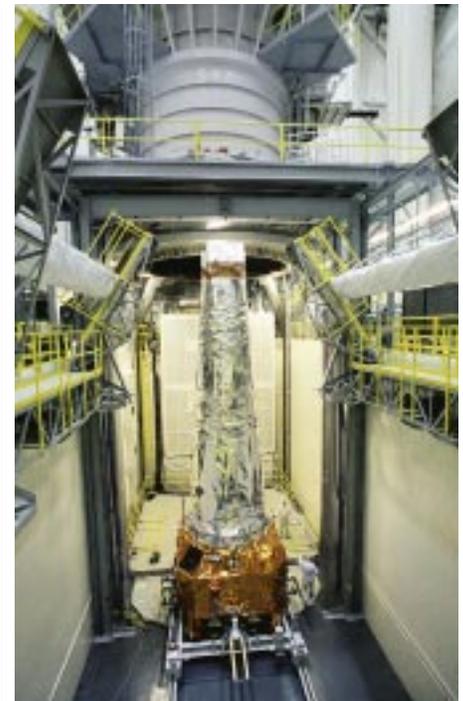


Artist's concept of Chandra X-ray Observatory.

the University of Chicago until his death in 1995.

The Chandra X-ray Observatory will help astronomers worldwide better understand the structure and evolution of the universe by studying powerful sources of X-rays such as exploding stars, matter falling into black holes and other exotic celestial objects. X-ray astronomy can only be done from space because Earth's atmosphere blocks X-rays from reaching the surface. Chandra will provide images that are 50 times more detailed than previous X-ray missions. At more than 45 feet in length and weighing more than 5 tons, it will be one of the largest objects ever placed in Earth orbit by the Space Shuttle.

Tyrel Johnson, a student at Priest River Lamanna High School in Priest River, Idaho, and Jatila van der Veen, a physics and astronomy teacher at Adolfo Camarillo High School in Camarillo, Calif., submitted the winning name and essays. They will receive a trip to the Kennedy Space Center to view the launch of the Chandra X-ray Observatory, a prize donated by TRW. In all, 59 people submitted the name "Chandra." Altogether, the contest drew more than 6,000 entries from all 50 states and 61 countries. The seven members of the selection committee included a top aerospace executive, journalists, scientists and a university professor.



Chandra X-ray Observatory.

Three Center scientists among eight from Alabama to receive grants

by Bob Thompson

NASA has selected 48 researchers — three of whom are from the Marshall Center and five from Huntsville and Birmingham — to receive grants totaling approximately \$33 million to conduct biotechnology research that may lead to new medical technologies.

As part of NASA's Biotechnology Program, the 48 grant recipients will study protein crystallization and cell science. This research, managed by Marshall's Microgravity Research Program, may result in improvements in structure-based drug design, tissue engineering and biosensor development.

NASA's biotechnology research has contributed information to the understanding of many diseases, including AIDS, heart disease, cancer, diabetes, respiratory syncytial virus and hepatitis. NASA's cell growth experiments have led to new research models in cellular and molecular biology and new tissues for transplant operations.

During NASA's selection process, 165 research proposals were peer-reviewed by scientific and technical experts from academia, government and industry. Forty of the grants are to conduct ground-based research, while the remaining eight will work to refine and fly experiments in

space aboard the International Space Station. Currently being assembled in orbit by Space Shuttle crews, the Space Station will be an orbiting laboratory built, worked and lived on by 15 cooperating nations. The orbiting laboratory is scheduled to be completed by mid-2002. Microgravity experiments are scheduled to begin by mid-1999. Thirty-four of NASA's 48 Biotechnology grants are for new research efforts. The remaining 14 grants are for continuation of current NASA-funded work.

The recipients from Marshall are:

Dr. Russell Judge, "Macromolecule Nucleation and Growth Rate Dispersion Studies: A Predictive Technique for Crystal Quality Improvement in Microgravity"

Dr. Craig Kundrot, "Optimizing the Use of Microgravity to Improve the Diffraction Quality of Problematic Biomacromolecular Crystals"

Dr. Marc Pusey, "The Role of Specific Interactions in Protein Crystal Nucleation and Growth Studied by Site-directed Mutagenesis"

Alabama recipients include:

Dr. Daniel Carter, New Century Pharma-

ceuticals Inc., Huntsville, "Protein Crystal Growth Facility-Based Microgravity Hardware: Science and Applications"

Dr. Lawrence DeLucas, University of Alabama at Birmingham, "Microgravity Studies of Medically Relevant Macromolecules"

Dr. Robert Naumann, University of Alabama in Huntsville, "Control of Transport in Protein Crystal Growth Using Restrictive Geometries"

Dr. Robert Snyder, New Century Pharmaceuticals Inc., Huntsville, "Electrophoretic Focusing"

Dr. Peter Vekilov, University of Alabama in Huntsville, "Effects of Connective Transport of Solute and Impurities on Defect-Causing Kinetics Instabilities in Protein Crystallization"

More information about Marshall's Microgravity Research Program experiments may be found at the following Web sites:

<http://www.msfc.nasa.gov/news>

<http://microgravity.msfc.nasa.gov/MICROGRAVITY/>

Personnel assignments announced

Marshall Center Director Art Stephenson has made three Center personnel assignments on an acting basis. James Kennedy, former deputy director of the Science and Engineering Directorate, has been named acting director of that directorate. Axel Roth, former director of Program Development, has been appointed acting director of the Flight Projects Office. Jack Bullman, former deputy director of Program Development, will assume duties as acting director of that directorate.



James Kennedy



Axel Roth



Jack Bullman



NASA photo

Showcase features Integrated Tech Strategy

The Marshall Center Optics Program recently displayed several technologies representing the new Office of Space Science Integrated Technology Strategy during the Office of Space Science Technology Showcase at NASA Headquarters in Washington, D.C. From left are David Lamb, University of Alabama in Huntsville graduate student; Marshall representatives James Bilbro, special assistant for Optics; Dr. Steve O'Dell, Space Sciences Laboratory; and Jeff Lindner, Structures and Dynamics Laboratory. Showcase attendees also included William Jones, EB52; Tom Koshut, ES81; and Edward Montgomery, PS01. The showcase was held in conjunction with a meeting of the Space Science Advisory Committee.

1998 in retrospect: Accomplishments abound at Marshall

January

- NASA and the Marshall Center began observance of the Agency's 40th Anniversary.
- NASA modified its X-34 contract with Orbital Sciences Corp. at Dulles, Va., to produce a second flight vehicle for the X-34 program.
- Marshall extended the Gravity Probe B effort by executing the cost-reimbursement option on a contract with Stanford University in Palo Alto, Calif.
- The launch of Space Shuttle Endeavour included five experiments managed by the Microgravity Program Office at Marshall.
- The Space Shuttle's first new, super lightweight external fuel tank was rolled out at NASA's Michoud Assembly Facility in New Orleans.

February

- NASA's most powerful X-ray observatory, the Advanced X-ray Astrophysics Facility, successfully completed the first of four mission operations tests.
- Marshall's X-ray Calibration Facility was inducted into the State of Alabama Engineering Hall of Fame.
- NASA and Lockheed saw their X-33 technology demonstrator move from drawing board to plant floor.
- Registrars from National Quality Assurance in Stanford, Conn., began conducting the audit for Marshall Center certification in ISO 9000.

March

- The turbo pump for the Fastrac engine arrived at the Marshall Center marking a major milestone in development of the X-34 Fastrac engine.
- Marshall inventors of a knee brace that uses Space Shuttle propulsion technology moved a step closer to being available to help knee injury and stroke patients when they turned over the final design and prototype to industry partners at Horton's Orthotic Lab in Little Rock, Ark.
- Assembly of the Advanced X-ray Astrophysics Facility was completed with the installation of its power-generating twin solar panels.
- Marshall was selected as the first National Society of Black Engineers Golden Torch Award winner in the

category of Government Diversity Leadership.

April

- Teams representing 15 colleges and high schools from across the country participated in the 5th annual "Great Moon Buggy Race."
- Engineers and scientists developing technology for an air-breathing rocket engine successfully completed one phase of component testing at Marshall.
- The launch of STS-90 included a Marshall Microgravity Research Program experiment that may help researchers to gain new understanding of human renal and bone marrow cells and tissues.
- A local Madison, Ala., hairdresser worked with Marshall researchers to use human hair to soak up oil spills in water.

May

- More than 26,000 people took a special look inside Marshall when it opened its doors to the public during an open house.
- The 25th anniversary of Skylab was commemorated during the open house.
- Computer Sciences Corporation was awarded a \$131 million contract option to continue services at Marshall.
- Marshall's Global Hydrology and Climate Center partnered with the Environmental Protection Agency and three U. S. cities to study how strategically placed "urban forests" and the use of reflective surfaces may help cool cities, reduce pollution, lower energy bills, modify growth plans and help mitigate further deterioration of air quality.
- As part of Marshall's Operations Support Services contract, EG&G Inc. personnel performed hazardous material inspections of reported inventories.
- NASA released the first images from instruments flying aboard the Tropical Rainfall Measuring Mission Lightning Imaging Sensor, managed by Marshall.
- An international team of astronomers led by scientists at Marshall made a discovery that confirms the existence of a special class of neutron stars dubbed "magnetars."

June

- At the recommendation of Marshall, NASA selected Oceaneering Space

Systems of Houston, Texas, for negotiations toward an agreement under which the firm would operate the Center's Neutral Buoyancy Simulator facility on a commercial basis, at no cost to the government.

- The launch of Space Shuttle Discovery, designated STS-91, included three Marshall-managed microgravity science experiments and the Marshall-developed first super lightweight external tank.
- The Marshall-developed Fastrac engine moved into assembly phase.
- A grant increase to help grow new technology-based businesses was awarded to the Business Technology Development Center Inc. of Huntsville, through Marshall's Technology Office.
- A team of scientists led by Dr. Chryssa Kouveliotou of Marshall used NASA's Compton Gamma Ray Observatory to detect a series of about 50 flashes from a star, a type called a Soft Gamma Repeater.

July

- The third Marshall-managed Space Shuttle super lightweight external tank was transported via barge to Port Canaveral, Fla.
- As part of the X-33 program under the Space Transportation Programs Office at Marshall, NASA's F-15B Aerodynamic Flight Facility aircraft successfully completed flight testing of Thermal Protection System material for the X-33 Advanced Technology Demonstrator.
- NASA's most powerful observatory, the Advanced X-ray Astrophysics Facility (AXAF), successfully completed a month-long series of rigorous tests at TRW Space and Electronics Group, Redondo Beach, Calif. The AXAF program is managed by Marshall for the Office of Space Science, NASA Headquarters, Washington, D.C.
- LB&B Associates Inc. of Columbia, Md., was selected for award of a contract to provide test operations support for Marshall's Science and Engineering Directorate.
- A Russian-built RD-180 rocket engine completed a successful 10-second test at Marshall's Advanced Engine Test Facility.

August

- The first wing assembly for NASA's X-34 technology demonstrator completed its qualification test and was shipped to

Orbital Sciences Corporation, Dulles, Va.

- Through research spearheaded by the Advanced Space Transportation Program at Marshall, NASA and its industry partners completed a series of tests demonstrating all the operating phases of an air-breathing rocket engine.
- The starboard truss segment, a main structural component of the International Space Station, was delivered to Marshall from the Boeing Company aboard NASA's "Super Guppy" cargo aircraft.
- As part of the Atlantic hurricane and tropical storm study — led by Robbie Hood, lead mission scientist, and researchers from Marshall's Global Hydrology and Climate Center — NASA flew a DC-8 aircraft into the eye of Hurricane Bonnie.
- Thousands of NASA and contractor personnel, retirees and their families celebrated NASA's 40th anniversary when Marshall held its annual picnic at the U.S. Space & Rocket Center.

September

- The International Space Station's Unity connecting module, manufactured by the Boeing Company at Marshall, was accepted by NASA at the Kennedy Space Center, Fla.
- NASA Administrator Dan Goldin announced the appointment of Art Stephenson, president of Oceaneering Advanced Technologies, Houston, Texas, as the next director of the Marshall Center.
- Dr. Werhner von Braun, who served as the first director of the Marshall Center from 1960-1970, was inducted into the Alabama Men's Hall of Fame at a ceremony in Birmingham, Ala.
- The Marshall Center received two ISO 9001 Registrations through its registrar, National Quality Assurance.
- Marshall marked a work stand-down day to dedicate the entire day to safety.

October

- NASA marked its 40th anniversary.
- Center saluted its charter members and their dedication to the space program.
- The first successful powerpack test of the X-33's Linear Aerospike Engine was conducted at the Stennis Space Center, Miss. Boeing's Rocketdyne Propulsion and Power Division builds the powerpacks and engines in Canoga Park, Calif. The X-33 Program is under the Space Transportation Programs Office at Marshall.
- Center Director Art Stephenson held his



Photo courtesy of The Boeing Company

The first utility rack for the U.S. Laboratory Module of the International Space Station was installed in April.

first Center all-hands meeting, encouraging employees not to worry about "external forces," but to focus on doing a "super job" so that "as we go forward with our roles and missions we are going to control our future."

November

- NASA selected OAO Corporation of Greenbelt, Md., to provide information technology services for the four Office of Space Flight Centers, including the Marshall Center, under the Outsourcing Desktop Initiative for NASA.
- A team of Marshall Center and Lockheed Martin personnel, working in support of the External Tank Shuttle Upgrades Program, achieved a major milestone in the use of friction stir welding.
- The air-breathing rocket — one of the technologies NASA's Advanced Space Transportation Program at Marshall is developing to make space travel affordable for everyone — successfully completed two years of testing.
- The STS-95 Space Shuttle crew completed a series of successful tests on a new video guidance component, the Automated Rendezvous and Capture System.
- The centerpiece of the International Space Station, the U.S. Laboratory "Destiny" was safely shipped from the Marshall Center to the Kennedy Space Center, Fla. Destiny was built by the Boeing Company at Marshall.
- Marshall's Astrionics Laboratory tested the flight command and telemetry communications system for the X-33 launch vehicle.
- Marshall engineers successfully tested the Fastrac engine thrust chamber assembly, marking the first test of the full-length

nozzle, which is similar to the flight configuration of the Fastrac engine that will power the X-34 technology demonstrator.

December

- The first U.S. International Space Station element — the Unity connecting node, built by The Boeing Company at Marshall — launched aboard the Space Shuttle Endeavour as part of STS-88.
- As a result of Marshall's Microgravity Research Program, University of Wisconsin freshman Katie Pedersen is a cancer survivor.
- NASA selected The Boeing Company of Downing, Calif., for negotiations leading to possible award of a four-year cooperative agreement to develop the first in a continuous series of advanced technology flight demonstrators called "Future X." The Future-X effort will be managed by the Space Transportation Programs Office at Marshall.
- STS-95 crew members visited Marshall to present employees and contractors with mission highlights.
- Marshall employees and contractors joined thousands of spectators during a parade in downtown Huntsville honoring the heroic STS-95 crew.
- An Earth Science Agreement was signed calling for researchers at the Global Hydrology and Climate Center at Marshall, at other NASA centers and in Central America to use satellite data to develop maps classifying the land cover of Central America.
- NASA's Advanced X-ray Astrophysics Facility was renamed the Chandra X-ray Observatory in honor of the late Indian-American Nobel Laureate Subrahmanyan Chandrasekhar.

Schwinghamer

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magazine really whet my appetite.”

Only a few months later, Schwinghamer noticed a trailer truck parked near Purdue. The driver was asleep and his cargo was covered with canvas. “You could tell it was some kind of a sleek aircraft without a propeller.” Intrigued by the mysterious looking cargo, Schwinghamer and a few fraternity brothers decided to get a closer look while the driver slept. Later, they determined that the cargo was probably the X-1 en route to the West Coast. “I always had stuff like that in the back of my mind,” Schwinghamer said, referring to the magazine cover and his initial unofficial encounter with space-related hardware.

“When I left college, though, I went to work for Sylvania Electric in northwestern Ohio. I got well founded in some aspects of chemistry, high-vacuum technology, and other things in the materials world.”

But after seven “good years” with Sylvania, Schwinghamer once again thought about finding a job working on missiles and rockets. He had read an article in Readers’ Digest about the arrival of Wernher von Braun

and his team in Huntsville in 1950. “I got a little bit of the itchy britches,” he said. So, Schwinghamer took a few days off from his job in Ohio and drove to Huntsville with his wife. “What I was exposed to didn’t appeal to me, so we drove back home. But I had picked up some literature here in Huntsville, and when I got back I realized,

wow, I hadn’t talked to von Braun and his German rocket team. So next day we get in the car and drive back to Alabama.”

Today, Schwinghamer is an internationally recognized inventor and an expert in the fields of aerospace materials and



NASA photo by Emmett Given

Prior to retirement after more than 40 years of service to the U.S. Army and the Marshall Center, Bob Schwinghamer, Marshall’s Associate Director, Technical, recalls career highlights.

process engineering. He calls accepting a job in Huntsville “the best decision I ever made.” He started federal service in 1957 with the U.S. Army Ballistic Missile Agency. “I got there in time to assist in the

Explorer I. I worked with the spin launcher that provided the stabilization for the upper stages on the Explorer launch vehicle,”

Schwinghamer said, recalling the celebration on the Courthouse Square in Huntsville when an Army Jupiter C launched Explorer I, America’s first satellite, on Jan. 31, 1958.

He participated with von Braun in the

development of the Redstone and Jupiter missiles. “The feeling that we were part of something national and international in scope was inescapable,” Schwinghamer said. “There was a certain sense of urgency about the whole thing. We

actually had people doing drawings out on the manufacturing shop floor. That wasn’t too nice sometimes in July in Alabama, but that’s how it was done. The Cold War was in full swing. You felt like what you were doing was really necessary for the good of the country.”

In 1960, Schwinghamer and other members of an expanded von Braun team formed the nucleus of NASA’s new George C. Marshall Space Flight Center in Huntsville. At Marshall, he served in both technical and managerial positions and contributed to the success of the Mercury-Redstone launch vehicle that launched Alan Shepard, America’s first astronaut, in 1961. “We had all kinds of welding problems in the early days. In respect to the Redstone, there was some spot welding that was giving us some trouble and I had the right kind of background to investigate that,” Schwinghamer recalled.

He also remembers the impact that President Kennedy’s commitment to the manned lunar landing had on Marshall and on the development of the Saturn V launch vehicle. “All the stops were pulled

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— Bob Schwinghamer

Schwinghamer

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out. At the high point we had about 7,500 civil servants employed at the Marshall Center. At that point, we didn't have computational fluid dynamics or computer aided design," Schwinghamer said. "We ran into some horrendous welding problems because of the size of the Saturn hardware. In those days I came in at 7 a.m. And it was usually dark, or later than dark, when I went home. We worked some incredible hours. There were no 40-hour weeks in the early days at Marshall. But nobody seemed to mind or complain. We were in a space race."

Even before the Saturn and Skylab programs ended, Schwinghamer was widely recognized for his dedication to maintaining the state of the art manufacturing and welding techniques. For example, he led Marshall's pioneering efforts in electron beam welding.

In addition, Schwinghamer was a key member of the Marshall team that designed the Skylab space station and then worked to save it when a critical solar shield ripped off shortly after deployment. "That was a day and night

thing again. Many days we worked all night long trying to come up with a design to save Skylab. It was excruciating. But we were successful," Schwinghamer recalled.

As the Marshall Center and NASA entered the Shuttle era, Schwinghamer served as director of Marshall's Materials and Processes Laboratory. Again, NASA called on him to head off a potential crisis. "Oh my goodness! The thermal protection system was falling off the external tank before it was launched. So we just packed up and went down there (to the launch site) Schwinghamer said. "I took some of my materials crew down there. We must have been there about six weeks. We found out that the materials that had been selected were adequate but they had been inadequately applied," Schwinghamer said, noting that some of the bonding techniques used on the thermal protection systems were later applied to the Shuttle solid rocket motor.

Schwinghamer also remembers the somber days that followed the Challenger accident in 1986. "I remember we worked every day from the end of January until about the 15th of June except Easter Sunday. There was a lot of pressure.

There were a lot of conflicting ideas. I was right in the thick of the fray."

Even after the Shuttle's successful return to flight in 1988, NASA called on Schwinghamer to lead a team to investigate and eliminate a series of hydrogen leaks that grounded the Space Shuttle for several months in the early 1990s. "I really felt a lot of pressure. I didn't sleep a lot at night in the motel in Florida. I worried a lot about the possibility of failing to find a solution."

Today as he discusses his plans for retirement, Schwinghamer believes he's most likely to be remembered at Marshall for his technical contributions and for what he calls "the technical watch dog function" he has held for the last four or five years. "Sure as heck, if you don't have somebody doing that, you'll end up reinventing the wheel again. It's not that you're so much smarter. It just means you've seen more."

Schwinghamer says his immediate plans for retirement include spending more time with his grandchildren. But he also plans to stay in touch with the Marshall Center. "And, if there is ever anything I can do to help the people at Marshall, I'll be ready to do it."

X-34

Continued from page 1

the U.S. Army's White Sands Missile Range, N.M., where the first two test flights will be conducted under the basic contract. This contract was signed in August 1996 to design, build and test-fly the X-34, a small, reusable technology demonstrator vehicle.

Once the X-34 has demonstrated safe and reliable performance at White Sands, the project then plans to move to NASA's Kennedy Space Center in Florida for a significant number of test flights to complete the test series. "We want to demonstrate that the vehicle can operate at a low cost (approximately \$500,000 per flight) at an operational range, and flights at Kennedy on the Eastern Range would give us the opportunity to do that," said X-34 project manager Mike Allen of Marshall Center.

These test flights of the X-34 will demonstrate low-cost reusability, autonomous landing, operations in subsonic travel through inclement weather, safe abort conditions, and landing in 20-knot cross winds.

The test series is expected to begin in early 2000, with the flights at Kennedy potentially starting later that year.

The vehicle will initially operate at speeds of Mach 2.5 (two-

and-one-half times the speed of sound), gradually increasing its speed to Mach 8 and reaching an altitude of 250,000 feet.

The X-34 will fly within the air space of the test range at White Sands. Operations at Kennedy would call for Orbital Sciences Corp. L-1011 carrier aircraft to take off from the Shuttle Landing Facility, fly over the Atlantic Ocean, and release the X-34. The X-34's newly developed Fastrac engine would ignite and power the vehicle 450 nautical miles back to the Shuttle Landing Facility in 15 minutes.

Total value of the X-34 contract, including the flight test option, now is \$85 million, with an additional \$16.7 million committed to direct support of X-34 by NASA Centers and other government agencies.

The X-34 is a single-engine, winged rocket, 58.3 feet long, 27.7 feet wide at wing tip and 11.5 feet tall from the bottom of the fuselage to the top of the tail.

Obituary

Cadle, Sam, 98, Mobile, Ala., died Dec. 16. Cadle retired from Marshall in 1970 where he worked as a sheet metal worker.

NASA and AIAA celebrate milestone anniversaries

A blue ribbon panel of aerospace leaders discussed their favorite career memories and hopes for the future of the space program when NASA and the American Institute of Aeronautics and Astronautics (AIAA) celebrated their milestone anniversaries at a joint celebration in Huntsville Dec. 14.

Approximately 100 people joined the Marshall Center and the Alabama-Mississippi Region of the AIAA for the event at the Holiday Inn-Research Park where NASA celebrated its 40th anniversary

and AIAA its 35th.

Center Director Art Stephenson, joined by Madison County Commission Chairman Mike Gillespie, Huntsville Mayor Loretta Spencer, Madison Mayor Chuck Yancura and AIAA/NASA Anniversary Chairperson Wanda Reese, welcomed attendees.

Stephenson recognized NASA leaders who made major contributions to the agency and to the Huntsville community. Stephenson also recognized members of Dr. Wernher von Braun's rocket team, past

Marshall Center directors, and charter and retired Marshall Center employees.

Blue ribbon panelists were Robert Schwinghamer, associate director, technical at Marshall; Dr. June Scobee Rodgers, founding chairwoman of the Challenger Center for Space Education; Dr. Ernst Stuhlinger and Konrad Dannenberg, retired Marshall employees and members of the von Braun rocket team; and Joseph Moquin, retired chief executive officer and president of Teledyne Brown Engineering.

Employee Ads

Miscellaneous

- ★ Dooney & Bourke purses, approximately 6"x8"x3", shoulder strap, \$40 ea. 837-0996
- ★ Aquarium, 27 gallon with oak stand, filter, light, \$75. 539-1850 days, 882-0546 evenings.
- ★ Ross 802 8-channel mixer w/3-band EQ Phantom Power XLR mic inputs, \$350. 828-4109
- ★ NordicTrac Achiever, \$300; PowerRider, \$75; dumbbell weight rack, \$75; various dumbbell weights, \$125. 881-8877
- ★ Dickens keepsake porcelain lighted buildings, church and fire station; \$20 each. 430-3290
- ★ Four 5-gallon propane tanks, \$12 each. 852-3501
- ★ Callaway Great Big Bertha driver, \$200; Ping Sedona 2-putter, \$40. 971-9710
- ★ Double kitchen sink, white porcelain, \$75 o.b.o. 539-7633
- ★ Whirlpool washer/dryer, apartment size, multi cycle, temperature, water levels, 2-speed, \$175. 883-7348
- ★ Flat bed trailer, 6-1/2' X 16', electric brakes, heavy duty, \$975. 859-4833
- ★ 1988 Stratos 279V bass boat, 17.5', 1988 Evinrude XP-150 motor, trail trailer, trolling motor, \$6,500 o.b.o. 464-3791

Vehicles

- ★ 1991 Cherokee Jeep Laredo, 4-door, all options, 112K miles, \$5,950. 837-0085
- ★ 1996 Pontiac Transport, 7/8-passenger, power door locks and windows, \$10,800. 772-7842
- ★ 1990 Chevrolet Lumina APV, 3.1L, 7-passenger seating, 93K miles, \$2,900. 837-6708
- ★ 1996 Red T-bird, 52K miles, V-8, AT, CD, moonroof, velour upholstery, \$12,200 o.b.o. 232-1050
- ★ 1990 Chevrolet Mark III conversion van, 23K miles, white/red, \$10,500. 536-3223 after 5 p.m.

Center Announcements

- ☛ **Training Opportunities** — The Employee and Organizational Development Office will offer several Program Management & Control classes during January, February and March. Classes will be limited to 30 people and registration is on a first-come first-served basis. No training request form is required. The courses and dates are: Earned Value Management, Jan. 26-28; Parametric Cost Estimation, Feb. 9-10; Configuration Management, Feb. 23-24;

Procurement Process, March 3-4; and PM&C: Tools and Techniques, March 29-April 2. Classes will be held from 8 a.m.-4:30 p.m. in Bldg. 4200, room G-21. Employees may register via AdminSTAR or contact Stephanie Elliott at 544-7553 or Renee Higgins at 544-8864.

☛ **Mandatory security briefing**— As a part of an on-going federal workplace security program, the Protective Services Office at the Marshall Center will conduct a series of security awareness and education briefings this month in Morris Auditorium. All Center and on-site contractor personnel are required to attend one of the sessions. Seating will be on a first-come first-served basis. The one-hour briefing will be given at 8:30, 10 a.m., 1:30 and 3 p.m. Jan. 11, 12, 19, 20, 25 and 26. One briefing is set for 8:30 a.m. Jan. 13.

☛ **Emergency Warning System Test** — The monthly test of the Emergency Warning System at Marshall is scheduled for 3 p.m. Thursday. This is an audio test only, and employees should not evacuate to protective areas. If severe weather is occurring at this time, the test will be rescheduled to a later date. Safety coordinators and monitors should send reports of malfunctioning speakers to: AB11/Emergency Preparedness Officer at 544-5187 immediately after the test.

MARSHALL STAR

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