MIJN RUIMTEVAART VERZAMELING DEEL 102

25 FEBRUARI 2004 T/M 24 MAART 2004.

REGISTER A T/M Z

A:

Apollo: blz 22375, 22376, 22400.

Atlas V: blz 22302, 22310.

B:

Boeing bouwt voor NASA
nieuw voortstuwingssysteem: blz 22277.

C:

Cassini bevestigt relativiteitstheorie
Met ongekende precisie: blz 22317.

Chandra Space Telescope: blz 22280.

Columbia ongeluk: blz 22286 t/m 22301, 22315, 22328 t/m 22371.

D:

Delta-4: blz 22384, 22385, 22386, 22387, 22388, 22389.

E:

Een zwart gat
per seconde erbij: blz 22306.

Enterprise.
De eerste shuttle gaat met pensioen: blz: 22379, 22380, 22381.

ESA en Japan samen naar Mercurius: blz 22389.

Europa wil ook naar Mars: blz 22209, 22210.

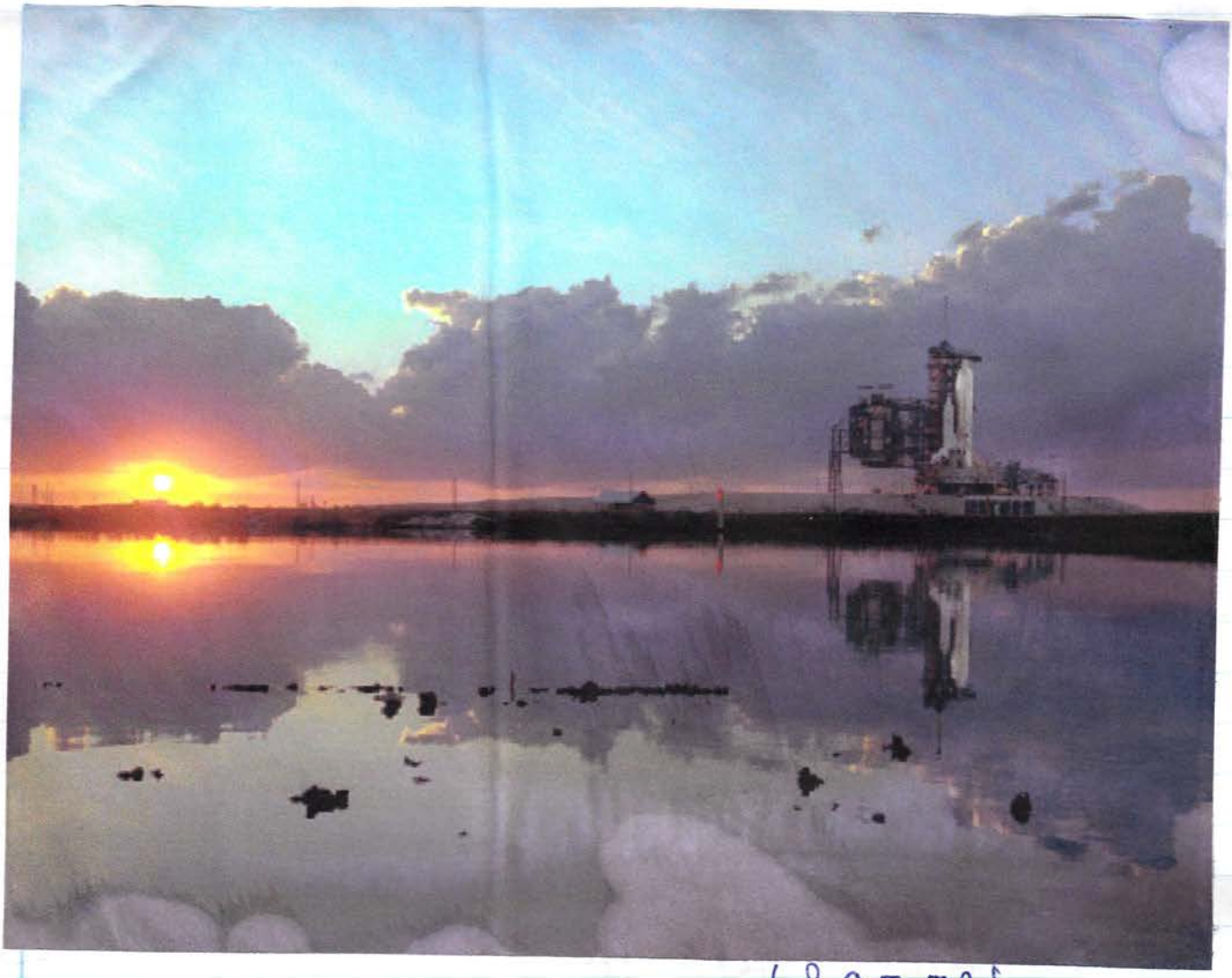
Explosieve ster vreet planeten: blz 22315.

G:

Glenn, John: blz 22202.

H:	Hubble Space Telescope:	blz 22278, 22282, 22303, 22316, 22317, 22319.
	Het Andromedastelsel eet de Sterren die haar begleiden traag op:	blz 22391.
I:	International Space Station:	blz 22204, 22205, 22280, 22281, 22283, 22284, 22285, 22304, 22305, 22309, 22310, 22314, 22367, 22373, 22390.
J:	James Web Space Telescope:	blz 22311, 22312, 22313.
	Jupiter missie gepland voor 2011:	blz 22314.
K:	Kibo op Kennedy Space Center:	blz 222314.
M:	Mars historisch dicht bij de aarde:	blz 22320, 22321, 22322, 22323, 22324, 22325, 22326, 22327.
	Mars Express:	blz 22279, 22373.
	Mercury-7:	blz 22377.
N:	NASA:	blz 22205.
	NASA heeft teveel astronauten:	blz 22202.
	New Start, BIG start:	blz 22319.
	Nieuwe Sojoez voor toeristen:	blz 22281.
O:	Onderwijzers de ruimte in:	blz 22373.
	Op weg naar eeuwige duisternis:	blz 22307, 22308, 22309.
	Orbital Space Plane:	blz 22393, 22394, 22395. 22396, 22397, 22398, 22399.

P:	Phoenix gekozen voor Mars 2007 missie:	blz 22277.
	Pluto:	blz 22303.
	Proton-raket:	blz 22302.
R:	Russische Ruimtevaart:	blz 22373, 22378.
S:	Saturnus V raket:	blz 22375.
	Saturnus-sonde bewijst Einstein:	blz 22315.
	Sealaunch:	blz 22374.
	Space Shuttle:	blz 22201, 22203, 22206, 22207, 22208, 22382, 22399.
	Soho:	blz 22392.
	Spirit naar Mars:	blz 22211 t/m 22275.
	Stardust:	blz 22282.
	Sterrenkunde:	blz 22306, 22372, 22373.
T:	Titan raket:	blz 22208.
	Titan heeft een zee van koolwaterstoffen:	blz 22392.
Y:	Yuri Malenchenko trouwt in de ruimte:	blz 22276.



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NASA has 'too many astronauts'

A review of the organisation, management and number of staff in the NASA Astronaut Office at Houston may lead to the cancellation of the planned call for a new astronaut class in 2004 and a therefore delay or cancellation of the appointment of future 'educator astronauts'.

There are 144 astronauts at NASA and over a third have yet to fly. There are still astronauts selected in 1996 that have not even been assigned a flight yet and crews have been selected for seven missions which will not be completed until 2005.

The first astronauts from a 2004 selection would not fly until 2009 and it has been estimated that the final mission specialist astronaut selected in the 2000 class of astronauts is unlikely to fly until 2010.

The loss of Columbia leaves NASA with three orbiters, likely leading to less missions per year. Flight rates are likely to be five a year compared with eight.

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Previous assigments of new classes of astronauts were made on the basis of overly optimistic flight rate predictions, the report says, adding that not all astronauts were being used in a manner commensurate with their expensive training.

Astronauts are being used to work on technical assignments that could be filled by other staff and this was being used to justify the larger number in the space corps, said the report.

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Buckling Down

Columbia accident board plans more interim recommendations before its final report

FRANK MORRING, JR./WASHINGTON

Atlantis, the next space shuttle orbiter in line to fly, was returned to the Orbiter Processing Facility on Mar. 14.

Members of the panel probing why the space shuttle Columbia broke up on reentry plan to issue a few more interim recommendations to give NASA a head start on flying shuttles again, and then will try to grind out a final report before the end of July.

Among recommendations the Columbia Accident Investigation Board (CAIB) will make "as soon as possible" is one calling for future mission management teams (MMTs), with overall responsibility for the conduct of shuttle flights, to be included in more preflight integrated simulations. Typically shuttle crews and their ground controllers work together in the exercises—most of them at Johnson Space Center—handling simulated emergencies designed to meld flight and ground personnel into a cohesive team.

"There are simulations that the MMT members go through, but they go through them very rarely," said CAIB member Sally Ride, the former astronaut. "They've all been held at [Kennedy Space Center] and they've all been related to prelaunch decision making or launch-abort decision making. . . . It seems to us to be an oversight that the mission management team is not being brought into that world of simulation to practice for making the decisions that need to be made during a mission."

Ride is part of a CAIB group studying the management decisions made during Columbia's final mission, including the decision that the chunk of foam that hit the orbiter's left wing leading edge did not pose a safety of flight issue to be tackled before reentry. During the mission, engineers supporting the flight worried that the MMT had not gotten a clear understanding of the analysis of the foam strike, suggesting confusion in critical lines of communication (*AW&ST* Feb. 10, p. 28; Mar. 3, p. 26).

A CAIB official said the panel hopes to issue at least three other interim recommendations before the end of June. NASA has already started acting on two others. It is following the CAIB suggestion to start state-of-the-art non-destructive evaluation of the reinforced carbon-carbon (RCC) panels that protect the shuttle-wing leading edges from the heat of reentry. It has also taken steps to ensure routine use of "the full capabilities" of the U.S. government to image shuttles while they are in orbit. In addition to reconnaissance satellites and ground-based sensors, NASA has included the in-orbit imaging capabilities of video cameras mounted on the International Space Station (ISS) and on shuttle robotic arms.

Technicians working for the CAIB are continuing ballistic experiments designed to test the CAIB hypothesis that the foam strike on Columbia's wing carried enough force to compromise the thermal protection capabilities of the RCC panels, opening a breach that let hot gases reach the aluminum structure. A June 6 test against flight RCC taken from the shuttle Discovery showed that foam fired from a gas gun, under conditions simulating the foam strike on Columbia, carried enough of a wallop to crack the RCC (*AW&ST* June 16, p. 64).

Last week, the testing continued, using fiberglass panels instead of the more expensive RCC to refine the experiment model. In a June 16 test, a piece of BX-250 foam, identical to the one used June 6, but with an impact point 3 in. lower, opened a bigger space between the panel and the adjacent "T-seal" than in an earlier fiberglass test. The first test raised the T-seal 0.4 in. above the leading edge surface, while the June 16 test raised it 0.625 in.

X-rays were planned to determine if the blow cracked the fiberglass, and a second test against fiberglass was scheduled. So far all of the tests have been against RCC panel 6, or its fiberglass surrogates. A critical test could come late this week when the CAIB plans to simulate a foam strike on RCC panel 8 from Discovery, incorporating what it has learned about the effects of foam strikes on the RCC material itself and the leading-edge RCC structure—against the most likely location of the strike on Columbia.

"Panel 8 is a very unusual panel, the

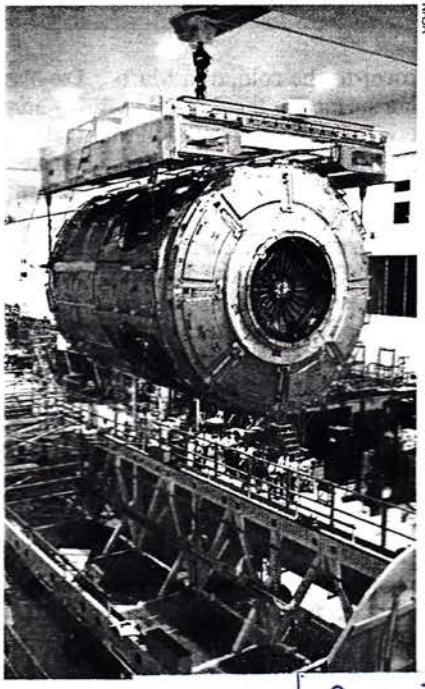
Extra Time

Columbus lab nears completion, but upgrades planned for utilization while shuttle is down

FRANK MORRING, JR./BREMEN, GERMANY

Technicians working on Europe's Columbus International Space Station (ISS) module here will soon begin integrating specialized experiment racks into the laboratory on a schedule that would support an October 2004 launch if there were space shuttles to carry it and a place to dock it once it reaches orbit.

Node 2, the Italian pressurized module where Columbus will be attached to the ISS, arrived at Kennedy Space Center, Fla., for processing this month (*AW&ST* May 26, p. 25). But with the shuttles grounded and ISS assembly stalled, both the node and Columbus are likely to remain in their terrestrial clean rooms indefinitely. The European Space Agency (ESA) and its contractors have agreed to use the extra time for upgrades on the laboratory module to make it more attractive for the scientists who have waited a decade longer than expected to get a crack at the microgravity environment it will offer.



NASA

Columbus, which will attach to the ISS at Node 2, is delivered to Kennedy Space Center this month

Already underway are negotiations for installation of a K_a-band antenna and related equipment to broaden the data stream coming down from Columbus. ESA and Europe's space industry have big plans for space station utilization once Columbus is in place, and the hope is that state-of-the-art communications gear will give the module an advantage in attracting commercial users later on.

"The utilization community, I think, will applaud that we are acting with our customer to deliver data management that is not based on a technology developed in 1980," said Stefan Graul, director of orbital infrastructure and operations at the Astrium Space Infrastructure facility here, which this week will be renamed EADS Space Transportation. "Now we are really trying to implement the technology at its actual status."

Graul noted the work will begin under a separate contract once EADS completes its fixed-price contract on Columbus, including installation of the internal payloads. Unlike NASA's Destiny laboratory, Columbus will be launched with its internal equipment already installed.

Last month the module's Biolab rack

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one where some of the debris evidence is saying the breach occurred," said CAIB member Scott Hubbard, the director of NASA's Ames Research Center, who organized the ballistic tests. "Panel 8 is the largest panel. It has some of the most unusual structure in the whole leading edge."

THE CAIB HAS SETTLED into facilities in suburban Arlington, Va., rented from the ANSER consultancy, to draft its report, which Adm. (ret.) Harold Gehman, the CAIB chairman, says he hopes can be completed before Congress leaves for its August recess. Although a writing staff has been hired for "consistency of tone," the CAIB members are writing the draft chapters themselves in a process that allows members to comment on cross-cutting issues as the writing goes ahead.

NASA is already making return-to-flight decisions in anticipation of the CAIB report (*AW&ST* June 16, p. 66), and Congress is gearing up for its own return-to-flight oversight when it returns in the fall. Gehman and the two congressional committees that will oversee preparations to reactivate the shuttle fleet—the House Science and the Senate Commerce, Science and Technology committees—have agreed on a procedure for sharing testimony that the CAIB received under confidentiality rules designed to promote candor. Designated committee and staff members can see and make handwritten notes on transcripts of the testimony, but the actual transcripts will be retained by the CAIB and there will be no public linking of testimony and witnesses.

Administrator Sean O'Keefe has said NASA will follow the recommendations of the CAIB "without debate." To monitor its implementation of the recommendations, the space agency has set up a special advisory panel that will be headed by Apollo astronaut Tom Stafford, who also heads an advisory task force that reviews ISS operational readiness, and by Richard O. Covey, a former shuttle pilot who is now vice president, support operations, for Boeing Homeland Security and Services (*AW&ST* May 26, p. 25).

MEMBERS OF THE "Stafford-Covey Task Force" include Richard Danzig (a former navy secretary, like O'Keefe); Apollo astronaut Bill Anders, the retired chairman and CEO of General Dynamics; former Air Force Chief of Staff Ron Fogelman, and Robert Sieck, a veteran shuttle launch director and former director of shuttle processing at Kennedy Space Center.

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arrived in Bremen from the EADS facility in Friedrichshafen, Germany, where it was assembled. Graul said on May 7 the biology experiment facility would be the first integrated after another two months of qualification testing on the module itself. On that schedule the module and its integrated internal payloads would be ready for delivery to ESA in mid-2004, he said.

However, the Columbia accident has halted more than the assembly sequence that would make a place for the European lab to dock with the installation of Node 2. It has also halted the discussions in the space station partnership on what the final ISS configuration will be, and who will fund the accommodations necessary to expand the crew beyond the original three.

THE TRICKIEST ISSUE is supplying lifeboats that can rescue all of an expanded crew in an emergency. Russia performs that task with a three-seat Soyuz vehicle now, but the Russian obligation to do so will end in 2006. NASA's proposed Orbital Space Plane is intended to take over the task eventually, but it faces obstacles in the U.S. Congress and almost certainly won't be ready in 2006.

Europe and Russia are working on a new station module where a second Soyuz rescue vehicle could dock (see story p. 190). But the question of who actually pays for the Soyuz remains tangled in U.S. anti-proliferation law, which forbids NASA from buying ISS hardware from Russia. So far, the Bush administration has not exercised its waiver authority under the law to ease ISS logistics while the shuttles are down.

"The partners are, of course, very worried, because we say if the U.S. in an emergency state isn't able to purchase Soyuz capsules, how should they ever under normal circumstances then purchase these capsules," said Joerg Feustel-Buechl, ESA's director of human spaceflight. "And, of course, as long as these Soyuzes—you need two of them per year—are not available, the station will stay with a crew of three, and that will, of course, be a major problem for the proper utilization."

With work on ISS hardware drawing to a close, ESA and its contractors are looking for the utilization payoff for their effort and investment. ESA this year published its scientific utilization plan for Columbus and other European assets on the station. In addition to Biolab, the European module will carry racks equipped for fluid science and physiology, as well as space for modular experiments and storage. A materials science laboratory is also planned, although it will not be launched with Columbus. Scientific instruments that need to be exposed to the space environment will be installed on the Columbus External Payload Facility mounted on the module's end cone.

European utilization plans have been built around 14 research "cornerstones" in six different disciplines—fundamental physics; fluid and combustion physics; material sciences; biology, physiology, and astro/exobiology and planetary exploration. In the latter discipline, for example, preparation for human planetary exploration is a research cornerstone, with such science "targets" as quantifying and understanding the risks of space radiation for humans, studying the effects of isolation in high-stress environments and simulating in situ resource utilization.

The plan was developed through a peer-review process in Europe's scientific community, which originally thought it would begin using Columbus in 1992, the 500th anniversary of its namesake's arrival in the Americas.

"The difference between us and [the] United States is in [the U.S.] NASA is deciding this plan," Feustel-Buechl said. "In Europe we are just providing the facilities, and asking the researchers to make this plan. So ESA is only the facilitator, but we are not the ones who decide what to do. We just tell them whether it is possible or not, whether we have the resources, but whether they do biology or medicine or materials science, and what they do in these areas, is purely a decision of the peer-review process, where the scientists decide on their own."

Supporting the scientific effort on the ISS is an important part of the business plans for Europe's space companies. In Turin, Italy, for example, Alenia Spazio has a large utilization facility—complete with a payload operations center and a neutral buoyancy tank to prepare astronauts for extravehicular activity—that is essentially standing empty in the absence of on-orbit European assets.

Josef Kind, Bremen-based president of EADS' human spaceflight and space transportation activities, said utilization will continue the revenue stream that has flowed to his company during the ISS development phase, although probably not at the levels of recent years.

"If we are very optimistic, then I see the revenue will be more than development, but for the first five or six years I don't see this," Kind said. "But I see opportunity coming through the existing and full range of ISS."

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LOOSE LIPS NASA is buying a secure voice teleconferencing system for its Washington headquarters, in part to ease the use of reconnaissance satellites, ground-based optical trackers and other highly classified military and intelligence hardware to inspect orbiting space shuttles to ensure they are safe for reentry. Pressed by the Columbia Accident Investigation Board, the civilian space agency already has inked an agreement with the Pentagon's National Imagery and Mapping Agency (NIMA) for the work. And Administrator Sean O'Keefe says cumbersome paperwork previously required for NASA to request help from the black world has been streamlined. Now the agency has opened bidding for a voice system that can handle multiple users "up to a Top Secret/SCI level." Apparently the secrecy won't be limited to shuttle operations. As NASA continues to push for closer cooperation with the military on the National Aerospace Initiative, space nuclear power and other activities, a NASA spokesman says only that the system will support "national security conference calls."

AWST: 18-08-2003.

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Recasting Shuttle

As congressional hearings loom, O'Keefe calls Washington a 'logic-free zone'

CRAIG COVAULT/KENNEDY SPACE CENTER

NASA will use wind tunnel and computational facilities at the Langley and Ames research centers to totally recharacterize the aerodynamics of the space shuttle before the program returns to flight, reclassified as more of a developmental vehicle, than the operational space transport NASA has been trying to make it for two decades.

"Clearly there is more to understand about this vehicle and we have committed ourselves to doing that before we go back to flying again," said William Readdy, NASA associate administrator for space flight.

Both NASA and the Columbia accident board agree that from now on the shuttle project will be viewed—from a decision-making standpoint—much more like an experimental X-aircraft program than a fully operational system.

"WE NOW FIND THAT we still have got an awful lot more to understand about this vehicle. To put it into perspective, the X-15s flew 199 times and they were X-vehicles—the shuttle was just on flight 113," Readdy said.

The agency will also create a new Engineering and Safety Center at Langley as the focal point for more independent safety oversight of the shuttle and International Space Station programs.

The Columbia Accident Investigation Board (CAIB) has also issued long-awaited recommendations on in-orbit repair of shuttle thermal protection tiles and reinforced carbon carbon (RCC) leading edge and nose cap material, that must be instituted before flights resume.

Those recommendations include the need to eventually develop a fully autonomous repair capability—even on ISS missions—in the event any damage needs to be repaired before an ISS docking is possible, or after the shuttle has departed and cannot return.

And last week the board also issued other recommendations for better tracking camera capabilities at the Kennedy Space Center, criticizing the existing system for not providing the type of engineering data necessary to make post-launch engineering measurements.

NASA Administrator Sean O'Keefe, in a closed-door session with Kennedy employees, said that the accident board's final report, to be issued in late July, "is going to be really ugly," according to a tape of the event televised to Kennedy employees.

"My strongest fervent plea is 'don't be defensive'" about the CAIB findings, O'Keefe told the staff. "We have absolutely nothing to apologize for. We have done our best to work our way through this."

But while urging the workforce not to be defensive, O'Keefe himself became so—or, to some, perhaps offensive—in criticizing media coverage of the accident and the potential for "theatrics" in forthcoming congressional oversight hearings.

O'Keefe told the employees there is strong public support for NASA's recovery from the accident "in spite of news coverage" that, in his opinion, has included "a perfect recollection of things that never existed," he said without citing examples.

But NASA's concern about how it's portrayed by the news media was discovered last week to have been a factor in how Johnson Space Center Mission Control initially informed Columbia pilots Rick Husband and William McCool about foam-strike damage assessments.

A short note about the analysis was not e-mailed to Columbia until Jan. 23, a full week after the flight's launch. And then only because NASA managers were concerned the news media might raise it with the crew in air-to-ground interviews, which did not occur.

Aerodynamic pressure coefficients around Columbia, its external tank and solid rocket boosters, at Mach 1.2 and 33,000 ft. 57 sec. after liftoff, were calculated for an earlier mission by the Johnson and Ames centers using a Navier-Stokes computational fluid dynamics analysis. Colors indicate velocities in the flow field with whites and reds the highest. NASA will recalculate flows, especially between the orbiter and tank.

"This item is not even worth mentioning other than wanting to make sure that you are not surprised by it in a question from a reporter," flight director Steve Stich e-mailed the pilots. Stich then explained the foam debris hit as seen by launch tracking cameras. "There is no concern for RCC or tile damage. We have seen this same phenomenon on several other flights and there is absolutely no concern for reentry," Stich told the crew.

Two days later, a more detailed engineering review of the impact analysis and a videotape of the event was also

transmitted to the crew with the same conclusion.

O'Keefe also took a poke at the congressional forums where the accident board report will be reviewed.

O'Keefe told Kennedy workers, "Unfortunately, one of the things that is in my job description is that I get to go to the forums and venues where


NASA

theatrics seem to be the highest—congressional hearings and press conferences—those kinds of 'wonderful places' where folks typically do not have much of a balance or objective position.

"When you watch all that stuff going on, know that is part of the theatre that goes on in the Washington area—which is best described as a 17-mi.-wide *logic-free zone*," he said in the employee session.

But the last time O'Keefe testified in "the logic-free zone," Adm. (ret.) Harold W. Gehman, who heads the accident board, bluntly told O'Keefe and a Senate committee that "you find there's no there there," in NASA's safety organization (*AW&ST* May 19, p. 23).

Consequently, a key focus of the Gehman report will center on how a lack of independence by the agency's engineering staff disarmed its ability to function with potent oversight.

O'Keefe said that NASA now recognizes that deficiency, and will act to correct it across the agency, more strongly than called for by the Gehman board, which is focused on the shuttle system.

The formation of a new Engineering and Safety Center at Langley, with agency-wide authority for engineering oversight, will be one element of the plan.

Outgoing Kennedy Space Center director, former astronaut USAF Maj. Gen. (ret.) Roy Bridges will have formation of the safety center as one of his objectives as he takes over the Langley director role in the coming weeks. And Ralph Roe, the shuttle program's chief engineer at Johnson, will move to Langley to head the safety organization.

"THE AGENCY'S ENGINEERING capacity ought to be brought to bear on a range of different issues, and it needs the independence to step into whatever needs to be corrected," O'Keefe said in a later news conference. "Operations [managers] might otherwise say 'let me deal with that next time,'" he said.

As part of renewed emphasis on basic shuttle engineering, the agency is beginning to update the fundamental mathematical aerodynamic model of the vehicle during ascent, especially the complex interactions between the orbiter and external tank, which can affect debris transport and ascent heating.

"We want to understand the very complicated interaction of aerodynamic flow between the ET and the space shuttle orbiter," Readdy said. "There were things that we obviously did not understand. There is tremendous room to expand our knowledge. We clearly did not understand the aerodynamic transport mechanism that caused the foam on STS-112 to strike the skirt of the SRB" two flights before Columbia's mission.

"That transport mechanism assured people that [similar bipod debris] could not in fact strike the orbiter. We were wrong," Readdy said.

While Johnson and industry teams are making good progress on repair options for high-temperature black thermal protection tiles, repair options for RCC are more complex. Moreover, any repair option must not disrupt the aerodynamic boundary layer, which itself could spike localized temperatures catastrophically downstream of a repair, even if it had fixed a crack.

"Clearly there are a number of advances in materials that have occurred

in the last 20 years. We aim to take advantage of those and see what concepts we may apply," Readdy said. No decisions have been made yet.

And access is also a major issue. Readdy said it may be necessary to manifest the manipulator arm on every flight, equipping it with new extensions to reach currently inaccessible areas, while also adding other aids such as new exterior handholds (*AW&ST* June 30, p. 37).

THE CAIB recommendations, however, stressed the need for an eventual autonomous repair capability for use even if the shuttle cannot reach the ISS on an ISS planned flight. This could involve "abort to orbit" cases involving both physical damage and ascent energy problems. Those findings include:

- "Before return to flight, for missions to the ISS, develop a practicable capability to inspect and effect emergency repairs to the widest possible range of damage to the Thermal Protection System (TPS), including both tile and RCC, taking advantage of the additional capabilities available while in proximity to and docked at the ISS," the board said.
- "Before return to flight, for (Hubble-type) non-station missions, develop a comprehensive, autonomous (independent of station) inspection and repair capability to cover the widest practicable range of damage scenarios."
- "An on-orbit TPS inspection should be accomplished early on all missions, using appropriate assets and capabilities."
- "The ultimate objective should be a fully autonomous capability for all missions, to address the possibility that an ISS mission does not achieve the necessary orbit, fails to dock successfully, or suffers damage during or after undocking."

THE BOARD ALSO MANDATED that a minimum of three tracking camera views be available to observe shuttle ascents through solid rocket booster separation and that this be made part of the Launch Commit Criteria. It called for new camera assets and possible use of mobile-, ship- or aircraft-based imaging systems to watch all launches.

"The current long-range camera assets on the Kennedy Space Center and Eastern Range are inadequate to provide best-possible engineering data during space shuttle ascents," the board said. "Evaluation of STS-107 [external tank] debris impact was hampered by lack of high resolution, high speed cameras" capable of providing temporal and spatial imagery data, the board said.

Exploration Plans

Europe maps robotic route to Mars, with humans perhaps to follow, but Germany's unwillingness to participate could leave a big hole

FRANK MORRING, JR./NOORDWIJK, NETHERLANDS

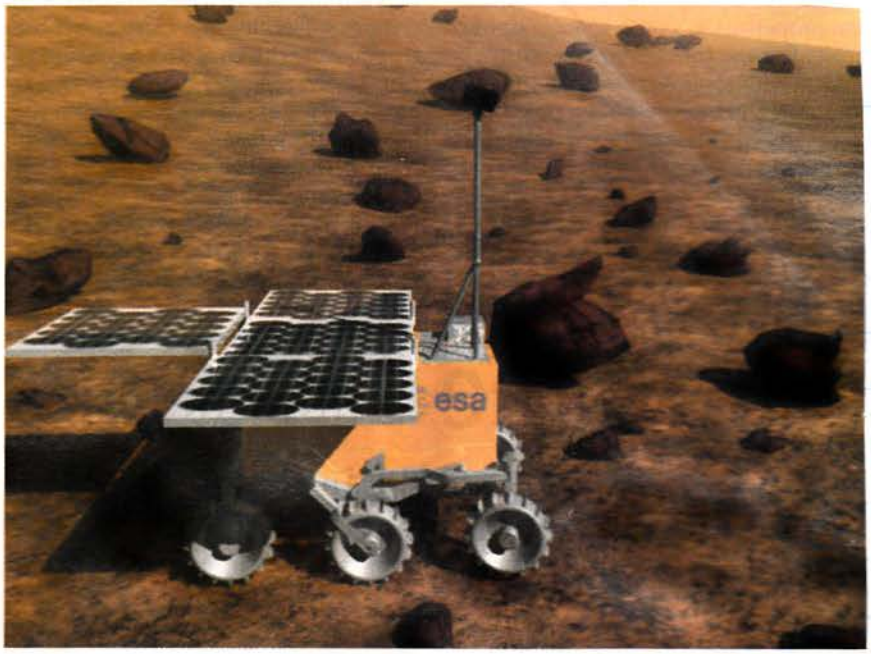
European Space Agency managers will seek more money to advance their plans for a life-seeking robotic Mars lander, but until the German government agrees to join the effort, ESA's long-term goal of a role in human Mars exploration seems stymied.

Work on Exo-Mars, the first major mission under ESA's ambitious Aurora program, has advanced to the point that its managers are ready to ask the science ministers of ESA member nations next year for funds to begin Phase B development, according to Bruno Gardini, head of the projects and concurrent design office in the Directorate of Technical Operational Support at the ESA Research and Technology Center (Estec) here.

The work has been hastened by the use of concurrent engineering techniques borrowed from the automotive and aeronautics industries, but both Exo-Mars and Aurora as a whole have suffered because the German Aerospace Center DLR has not joined Aurora despite widespread interest in German academia and industry.

"If we want to have a program which is rather ambitious, this program going ahead without German participation doesn't really make sense," Gardini said. "We hope to convince Germany to take part, and they can do so at any time because this is an optional program and they can always join, whenever it is convenient for them. And we hope this support can happen soon, because we are already seeing some difficulties."

As an example, Gardini listed the low-intensity, low-temperature solar cells developed in Germany for the Rosetta comet lander. The technology would also be extremely useful on Exo-Mars, which envisions launching a lander and rover to the cold, dim Martian surface in the 2009 planetary window on a mission to find the chemical signatures of life on or near the surface.



Exo-Mars, the first big science mission that would be mounted under ESA's Aurora program, aims to land a life-seeking rover on the Martian surface.

But Exo-Mars is only the first in a series of Aurora projects designed to give Europe a role in some as-yet-unplanned future international effort to send humans to Mars. The program was launched at the 2001 ESA ministerial in Edinburgh, Scotland, to study robotic exploration missions that would lay the scientific and engineering groundwork for human Mars exploration in 2025 or so.

"In the past, there have been studies from NASA, from Russia, but very little was done in Europe," Gardini said. "So what we are trying to do is to establish a road map to human exploration of Mars."

ESA planners asked the science ministers in Edinburgh for 40 million euros ($46 million) to spend over five years, and got 14 million euros for three years. At the next regular ministerial, expected at the end of 2004, ESA will present a detailed plan for Aurora that includes both "Flagship" missions like Exo-Mars and less-ambitious "Arrow" missions designed to bring new technology for space exploration to the point that it can be used.

Flagship missions are comparable in scale and cost to the deep-space "cornerstone" missions that are a mainstay of ESA space science activities. In addition to Exo-Mars, the agency is also studying a Mars sample return mission that would fly sometime after 2009.

"We are looking to what we call a minimum mission, where the main task

is to take a sample and bring it back, without having rovers going around the surface collecting samples," Gardini said. "It is less ambitious than previous NASA mission concepts. It is a minimum mission, but even that is a tremendous challenge, for Europe to be sure, and in general."

One early Arrow mission under consideration to support the Mars sample return activity is a test of a direct-reentry capsule that would deliver Martian material directly to Earth from an interplanetary transit, without violating established planetary protection rules. Another, which would support a number of different Mars missions, is a demonstration of aerocapture at Mars—using the planet's atmosphere instead of chemical propellant to slow a spacecraft into orbit after the Earth-Mars transit.

Other ideas under study in the Aurora program include a lunar mission to test in situ resource utilization techniques that could some day support a human mission to Mars, generating fuel or oxygen from extraterrestrial material and gases. And ESA is working with Russia's Babakin Science and Research Space Center on an inflatable aerobrake for Martian reentry that would save weight on launch from Earth and ease a probe to the surface of Mars "like a leaf."

"It is extremely attractive, but not yet qualified," Gardini said. "There is quite a lot of work to be done, but with this inflatable braking device you could land vertically, so you would not go bouncing around like you do with airbags. However, in our studies we have not discounted airbags either."

GARDINI IS ALSO responsible for the ESA Estec Concurrent Design Facility, where engineers gather in a single room for intensive Pre-Phase A design work that lends itself very nicely to the sort of concept studies underway in the Aurora program. Set up with computer work stations something like a spacecraft control center, the concurrent design facility brings together experts in such areas as systems, instruments, mission analysis, propulsion, attitude and orbit control, thermal control and cost analysis to hammer out mission concepts in relatively short order.

"Concurrent engineering is a methodology where you try to do the design as much as possible in parallel," Gardini said. "The most important thing is, if you work in that way, with a team and everybody present, the efficiency increases significantly. People are forced to do design almost in real time. It forces people to look across the interface. It ensures a design that is consistent. It is also a rather stressing way of working, because it is open to everybody."

In an interview on May 6, Gardini said he hoped the ESA ministerial held May 27 would create conditions that could bring Germany into the Aurora program. "We know there is a lot of interest from industry and the scientific community, but we have to wait," he said.

One of those in German industry who is interested in the program is Josef Kind, president of Astrium Space Infrastructure and the prime contractor on the Automated Transfer Vehicle ESA has developed for the International Space Station (see story p. 186).

"You know in the space world you have a lot of nice, creative, engaged engineers, and they said if we go to Mars the ATV could be a part of the vehicle," Kind said on May 7.

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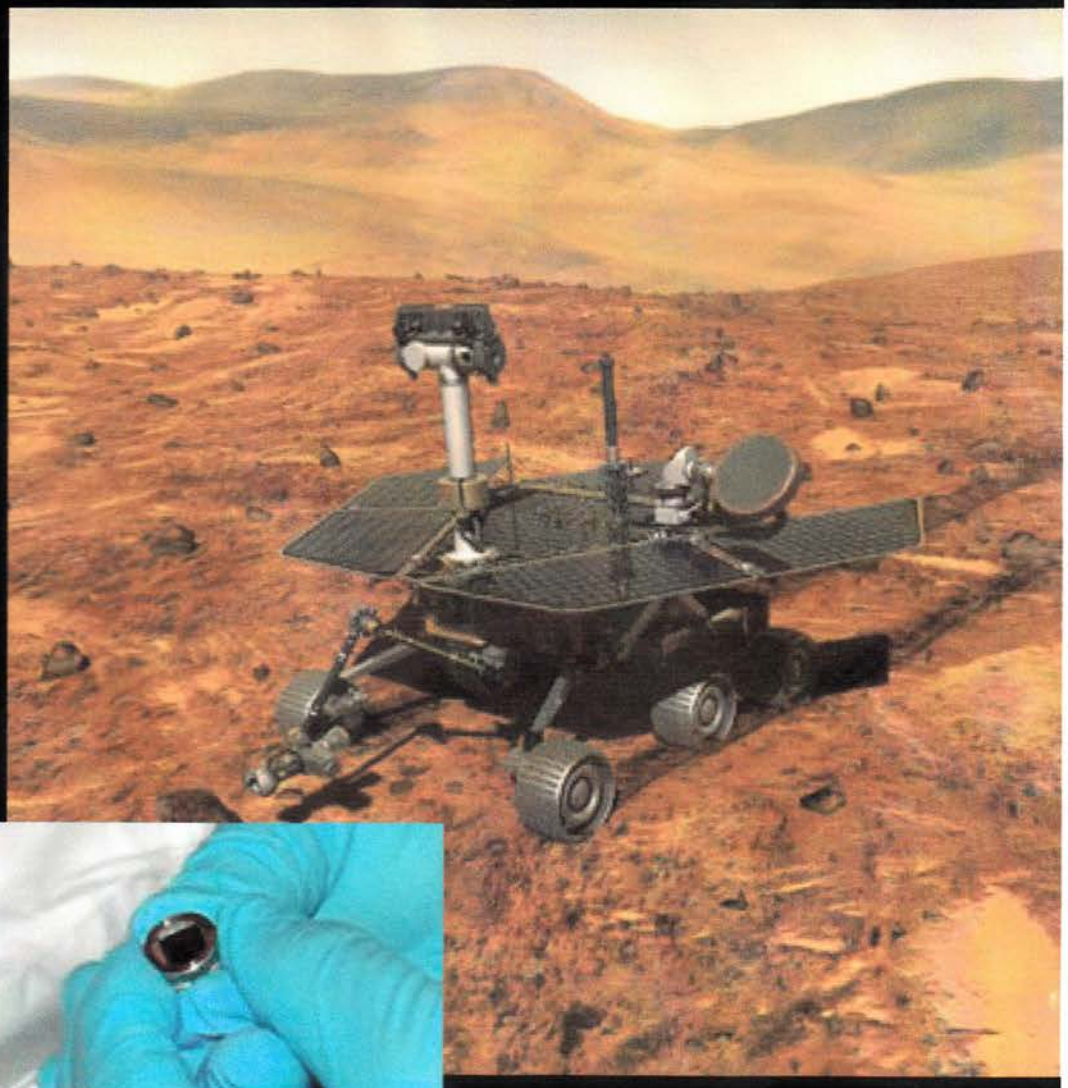
Mars Exploration Rover Mission

SPIRIT

MER-A

10 juni 2003

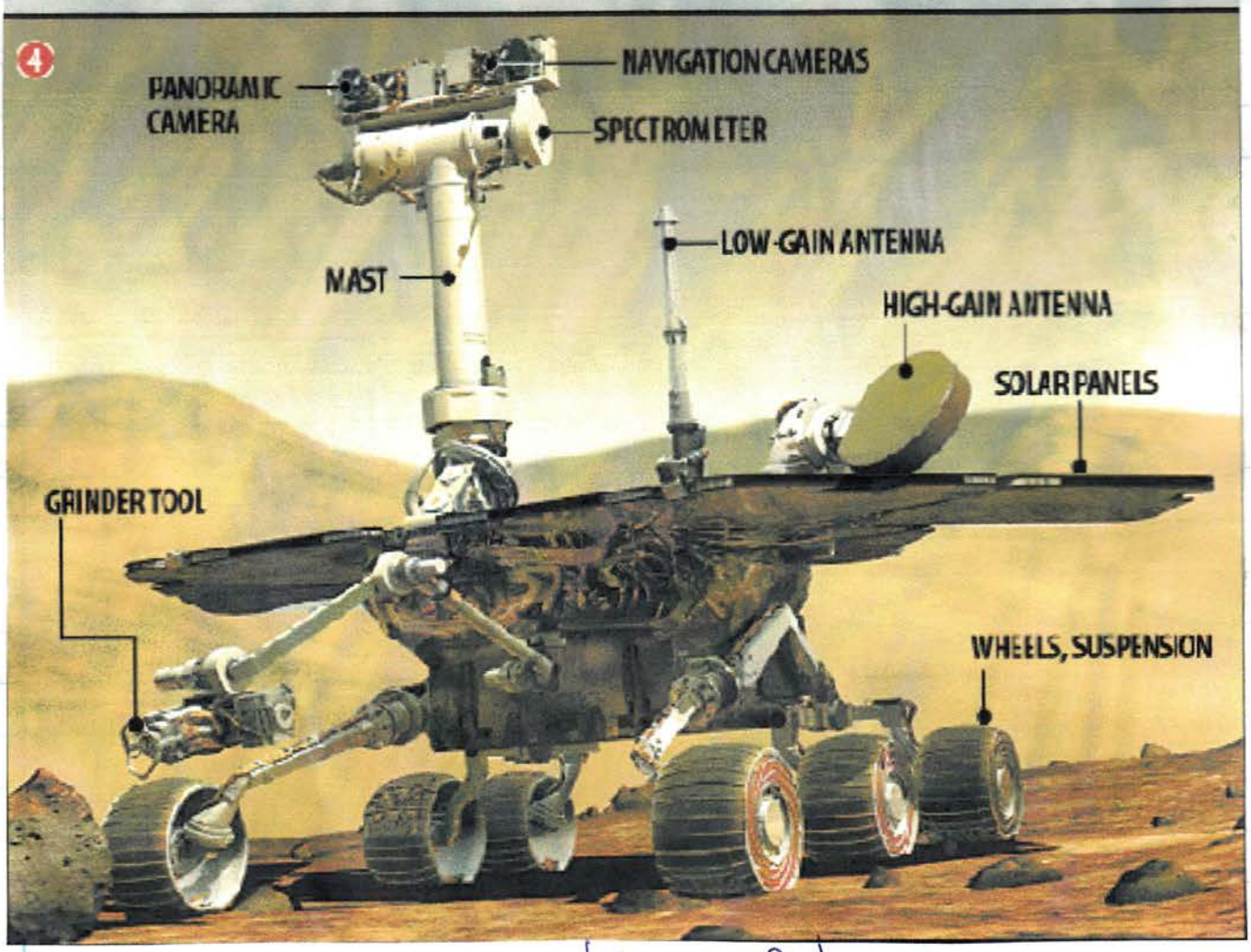


Spirit launched
June 10, 2003

Opportunity launched
July 7, 2003

NASA set to roam Red Planet again

Today, NASA is set to launch the 1st of 2 rovers that will comb the surface of Mars, analyzing rocks and minerals in hopes of uncovering the Red Planet's watery past. Both of the Mars Exploration Rovers — the 2nd is scheduled to launch June 25 — are expected to reach Mars in January.



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FLORIDA TODAY : 04 SEPTEMBER 2002.

SCIENTISTS TEST NEW MARS ROVER FOR UPCOMING MISSION.

CAPE CANAVERAL - The launch of the next Martian rover is nine months away and counting. Astrobiologists, atmospheric scientists and geologists already are rehearsing their parts. Many Mars explorers attended a 10-day summer camp last month to prepare them foor working on the Red Planet. Three spacecraft head to Mars next year. A common element of all three missions is the search for water, which would indicate Mars could support life. Scientists through the ages have wondered whether anything ever lived on Mars or ever could. In May, the first of NASA's Mars Exploration Rovers is scheduled to launch from Cape Canaveral Air Force Station. A month later, a twin rover will follow. If successful, the missions will be the first to land safely on the surface since the Jet Propulsion Laboratory's 1997 triumph, Pathfinder. "Pathfinder was a technology demonstration mission," said John Callas, science manager for the Mars Exploration Rover mission. "The MER mission is very much a scientifically driven mission." For the field test, a test rover was placed at an undisclosed location in the arid Southwest and scientists at NASA's Jet Propulsion Laboratory in Pasadena, Calif., had to send commands to the robot to find out more about the Mars-like region. For some, it was the first time they were thrown into a room making fast decisions on a mock mission. Next year, when they have to make those choices for real, any one of them could affect the outcome of a $740 million mission. The Mars Exploration Rovers will be different than the traditional method of mission planning where everything is mapped out in advance, Callas said. "We need a science team that is very flexible and very nimble, able to make high-quality decisions in a short amount of time," Callas said. Geologists who are used to going to a site with their rock hammer and seeing and feeling their specimens will have to get used to letting a robot do that for them. But a lot has to be done before that can happen. "It's the most fast-paced flight project I've ever been associated with," said Steve Squyres, the mission's chief scientist who also worked on the 2001 Mars Odyssey spacecraft. For one, the actual rovers aren't finished yet. Scientists are doing their tests with a rover called FIDO, short for Field Integrated Design Operations testbed. Then the new rovers must undergo a battery of safety tests. One will include dropping a backup bot out of a helicopter to test the airbags that will cushion the blow of landing on the surface. In March, they will be packed and shipped to Cape Canaveral for their launches. The Mars-orbiting Odyssey and Global Surveyor probes still are collecting pictures and data about the four proposed landing sites. The final two sites will be selected in March. "The longer we wait, the smarter we'll be," Squyres said. Through this pair of rovers, McLennan will study where sediments on Mars came from. Sedimentary rocks are essentially igneous, or volcano-formed, rocks that the environment has altered. By studying specific types of rocks and dust, he hopes to find out how they changed. Perhaps it was by climate or even by water. "I'm sort of vaguely agnostic about landing sites," said Scott McLennan, a professor at State University of New York, Stony Brook. All would suit his needs. Their mission: hunt for signs of water. NASA's thinking is where there is water, there could be life. To make things a little harder, scientists will live and work on Martian time. One Martian day is 24 hours, 39 minutes. "That 39 minutes makes life really complicated," Squyres said. So say their daily operations meeting is at noon one day. The next day it would be at 12:39 p.m. "Three weeks from now it's in middle of the night." Operating two rovers at once will present its own set of challenges. For example, if they pick landing sites that are 12 time zones apart, it will be hard for scientists to hop from one rover team to another. They will be required to take a few days off to catch up on lost sleep. Like NASA, the European Space Agency and Italian Space Agency are tracking down the wet stuff. The agencies will send off their own mission to Mars next June called Mars Express. This spacecraft will join the small armada of probes orbiting the planet and hunting for water. NASA already has 2001 Mars Odyssey and Mars Global Surveyor flying around the planet. Express also will send a lander to the surface. NASA is helping to design Express's radar system. People can send their name to Mars on the NASA rovers for free. Those interested can sign up at http://spacekids.hq.nasa.gov. So far, 2.7 million people have submitted their names. NASA will save all of the names on a small DVD that will ride along with the rovers through their Martian adventures. This has become sort of a tradition for Mars missions. Many names were supposed to fly to Mars on a CD-ROM on the Mars Polar Lander, but that spacecraft was destroyed on its descent to the Red Planet. And NASA also collected names for its 2001 lander, but that program was cancelled. Those names were transferred to next year's project.

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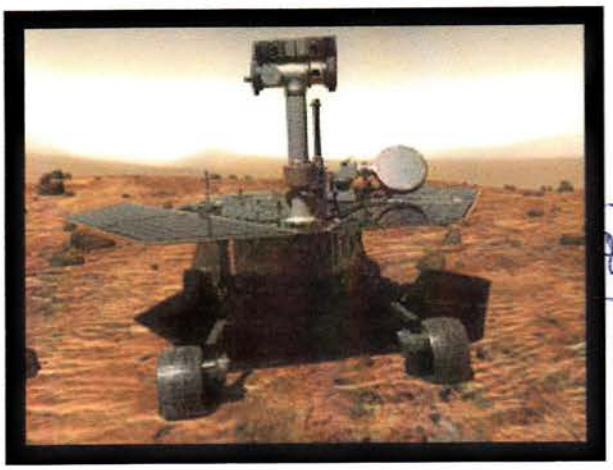
What Do You Mean? | Sign Me Up! | More About the Mission
Current News | Home | Name Search

Previous "Sign Me Up" Campaign

What Do You Mean?

4 - 3 - 2 - 1 - Ignition - Liftoff !



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In 2003, twin Mars Rovers will be launched towards the Red Planet. Once on the surface, the Rovers will be able to travel significant distances and use several instruments to help scientists determine the climate and water history in Mars' present and past.

"Everyone on Earth who has ever dreamed of being an explorer on an alien planet will want to go along for the ride as we explore the surface of Mars" invites Dr. Ed Weiler, Associate Administrator for the Office of Space Science. So please join us on this exciting journey of learning and exploration by including your name on the Mars Name Disc!

OK, What do I do?

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You can send your name to Mars by typing your name into and submitting this form. Once you have done this you will receive a "Success" page where you will be able to print a commemorative certificate and bookmark it for later viewing. All the names collected will be recorded onto a small DVD disk that will be attached to the lander that will travel to the surface of Mars. The DVD disk and its mounting assembly are being provided as part of the Red Rover Goes to Mars educational experiment on the Mars Exploration Rover-2003 mission. Each rover will photograph and return to Earth a picture of each DVD disk of names as they rest on the Martian surface.

Responsible NASA Official: John Lee
Curator: George Varros
Last Updated: July 9, 2002

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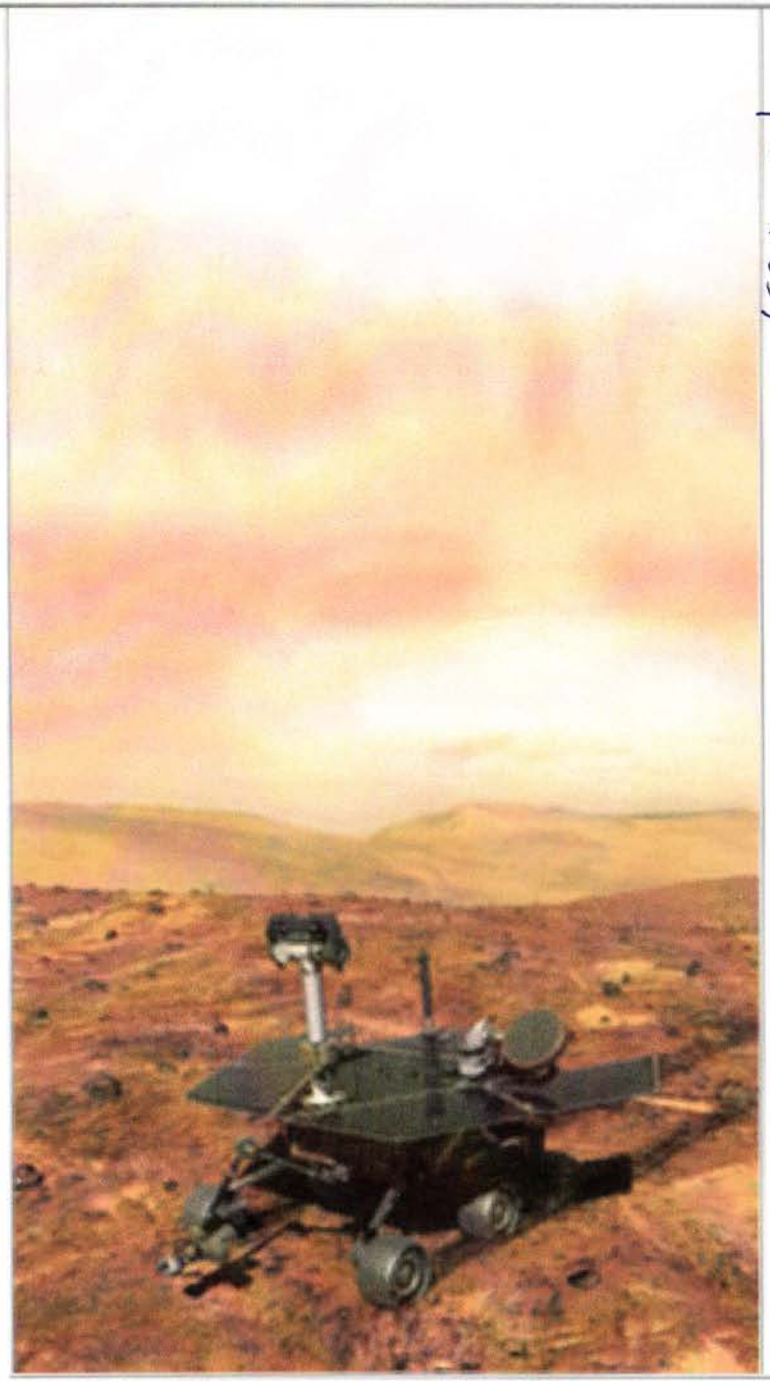

Participation Certificate

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Presented to

Dave D.J.F. Böskes

On September 6, 2002

Thank you for joining us on this mission of exploration and discovery. A compact disc bearing your name will be included in one of the next Mars Exploration Rover-2003 missions that will explore the planet's surface in search of geologic evidence of water in Mars' past.

Together, we will journey into space to discover and understand the many wonders of our universe.

Edward J Weiler

Dr. Edward J. Weiler
Associate Administrator
Office of Space Science

Certificate No. 2780684

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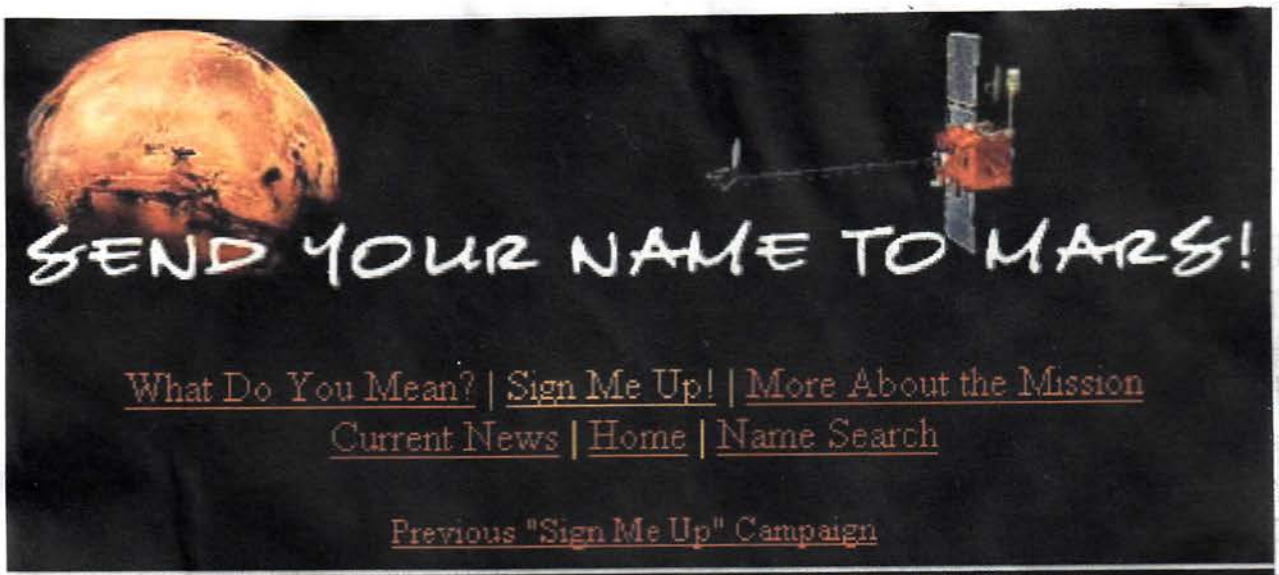

Success!

Your name has been entered into the Mars Name Disc list!
Note: Click on the link below to receive your certificate.

Set your printer to Landscape before printing the certificate.

Dave D.J.F. Böskes - Certificate No. 2780684

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SPACE.COM : 27 SEPTEMBER 2002.

ASTRONOTES : FUTURE MARS ROVER PARACHUTE PASSES KEY TEST.

The last thing a parachutist wants to see is his chute rip into shreds as it opens. Yet this is what members of the Mars Exploration Rovers (MER) Entry, Landing and Descent team have been seeing for months. Prototype chutes were put into a big wind tunnel at NASA's Ames Research Center. They would deploy fine but failed once they filled with air. A torn parachute would be very bad news for the twin MER rovers slated to land on Mars in 2004. Last week, finally, the team successfully tested a chute. They will continue testing until scheduled to build the actual flight chute in November. The chute will, hopefully, slow down the MER lander. The craft will also deploy airbags, similar to the ones used in the Pathfinder mission, to bounce across the Martian landscape before coming to a stop.

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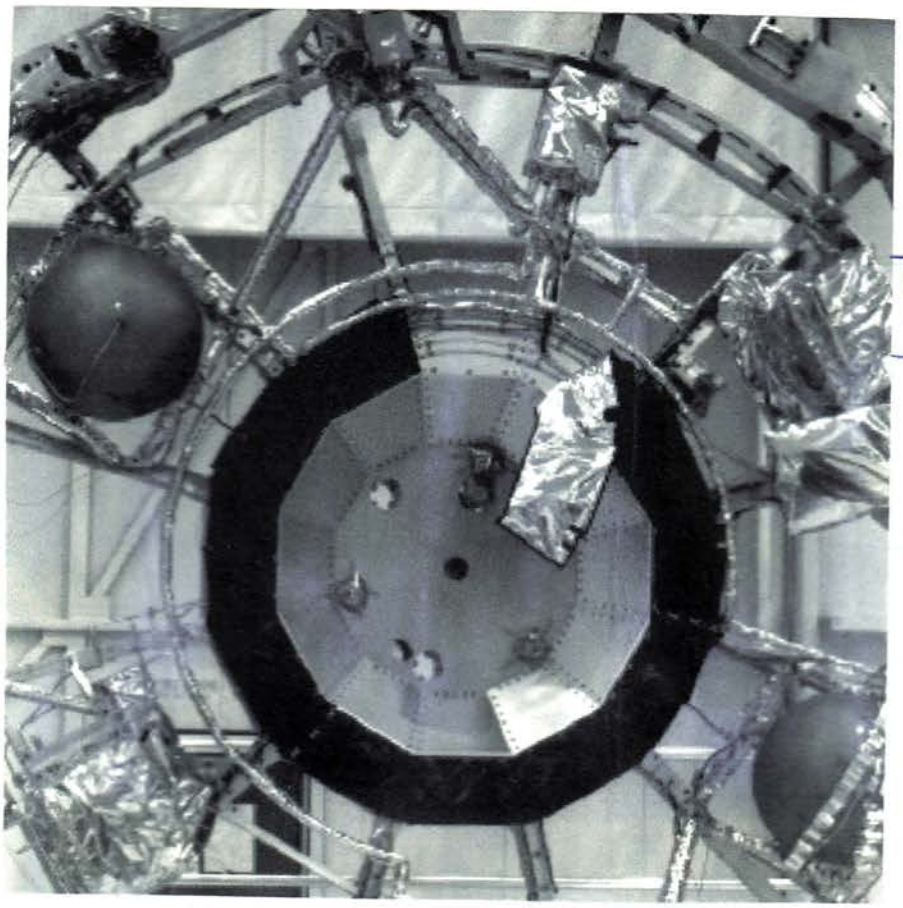

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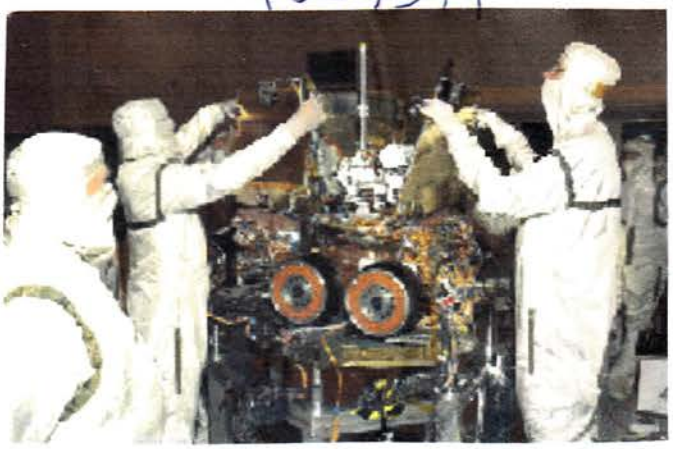

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SPACE.COM : 09 OKTOBER 2002.

NASA "CAUTIOUSLY OPTIMISTIC" MARS ROVERS WILL BE READY FOR LAUNCH.

CAMBRIDGE – Will it be twins for NASA? The space agency's Mars czar is "cautiously optimistic" that two interplanetary robotic rovers will be ready in time for sendoff next year to the red planet. Spacecraft engineers and software specialists engaged in preparing the Mars Exploration Rovers (MER) are racing to meet a series of major milestones over the next several months. Overall testing of the robots has proven more costly than budgets allowed, forcing a recent internal overhaul of the program. Later this year and in January, two independent groups are to scrutinize the overall MER project. They are being convened to give a thumbs-up or down on whether the rovers are ready for an assault on Mars and can carry out their assigned duties. "They have had a lot of challenges...suffered a lot of setbacks," said Orlando Figueroa, Director of the Mars Exploration Program office at NASA Headquarters in Washington, D.C. "Although the MER team has been very resourceful in finding solutions, it has clearly created a lot of stress on the budget," the NASA Mars chief told SPACE.com. Figueroa was attending Mars Week, held here October 4-6 at the Massachusetts Institute of Technology (MIT).Figueroa said that both NASA Headquarters and the Jet Propulsion Laboratory (JPL) in Pasadena, California -- the organization responsible for the MER project -- constantly focus their attention on technical, cost, schedule, as well as human health and safety issues."We started to notice signs of stress once again in cost," Figueroa said.

Specifically, new expenses were largely driven by more tests of the MER airbags and parachute system. "Any component of the entry, descent and landing system we're going to test to death. We can't cut corners on that," Figueroa said. Go ride the logic train One electronics problem has popped up. Field Programmable Gate Arrays (FPGA) used in each MER were thought to be under-achievers. These industry-supplied FPGA devices are programmable and a class of general-purpose chip that can be configured for a wide variety of applications. In the case of the MER effort they allow software designers to custom design logic trains within each rover. During FPGA tests, problems started showing up. Replacing the units meant risk to the project's tight timelines. A backup batch of the chips has been purchased as a precautionary step. Further testing has better characterized this concern, leading MER project officials to perhaps replace only a few of the FPGA elements versus a massive overhaul. "It appears that we are in the right direction. We don't need to replace them...right now," Figueroa said. "All these things were raising flags that cost, once again, was an issue," he said. The MER program is an $800 million effort. It's what NASA calls the "soup to nuts" or beginning-to-end costs. This total life cycle expense includes launch and operating the rovers on Mars. In recent assessments, however, the program was clearly going to break the bank, Figueroa said, predicted to be something on the order of $13 million to $15 million beyond budgeted resources. The word from NASA Headquarters was that the MER program has no more available funds. Both NASA and JPL officials took a major look within the MER project to find needed funds and to build up an internal pot of reserve cash."The MER team went through line item by line item. We revisited the plan for delivery of components making sure that things weren't being cut too short on anything," Figueroa said. Over the last month, indicators are "pretty darn good" for the MER program, Figueroa said, with airbag and parachute system tests, as well as electronic component checkout, yielding good results. "The integration and testing program is going great. At least over the last week, things are looking really good. We have reason to be cautiously optimistic," he said.

The Mars Exploration Rovers are to be individually boosted on Delta rockets from Cape Canaveral, Florida. Rover A on May 30, 2003(landing on January 4, 2004); Rover B on June 27, 2003 (touchdown on January 25, 2004). If that first launch window is missed, there is an opportunity to hurl a MER rover toward Mars in that second launch window using a more powerful Delta booster. Missing the launch windows to Mars entirely in 2003 could lead to MER sendoff the following year. But 2005 is horrible in terms of launch windows, Figueroa said. "I think we have to do everything within our power to keep the two rover program as we envisioned it. We are nowhere near what I would say is 'let's go out and cheer' but we have reason to be optimistic," Figueroa said.The MER program was predicated, for the most part, on being a copycat craft based on the Mars Pathfinder success in July 1997. That turned out not to be the case. Changes in the airbag and parachute system, and other aspects to support the much heavier MER robots, created troublesome issues. A domino effect of problems surfaced that, in turn, led to stresses on the project's budget. Now being selected, Figueroa said, is a small group of individuals that will penetrate the MER program to assure the rovers are ready for flight. This group would begin their assessment in the November-December time frame. Another group of experts will be assembled to do an end-to-end review of the entire entry, descent and landing system sequence for the twin rovers. They will start this appraisal in January.These assessments would clear the way for shipping the rovers to Florida for their respective launches. For MER workers at JPL, it's beyond nail-biting time in building up each of the rovers, mounting instruments, and carrying out final checks. The pressure is on full force."We're watching human health and safety...whether adrenaline gets ahead of physical capability. They've managed that well. I think that the whole laboratory has rallied behind them. The whole place is humming as hardware comes together and moves into place," Figueroa told SPACE.com Despite best efforts, however, landing safely on Mars remains a challenge. If the twin rovers wind up scattered across Martian terrain, the ripple effects from such failures would clearly impact NASA's Mars exploration plans. "It's an incredibly complex mission. This is life. It's a tough business. I think, obviously, there is great expectation for the success of at least one of these rovers - at least one. So a double failure, I think, would be very tough for us to recover from," Figueroa said.

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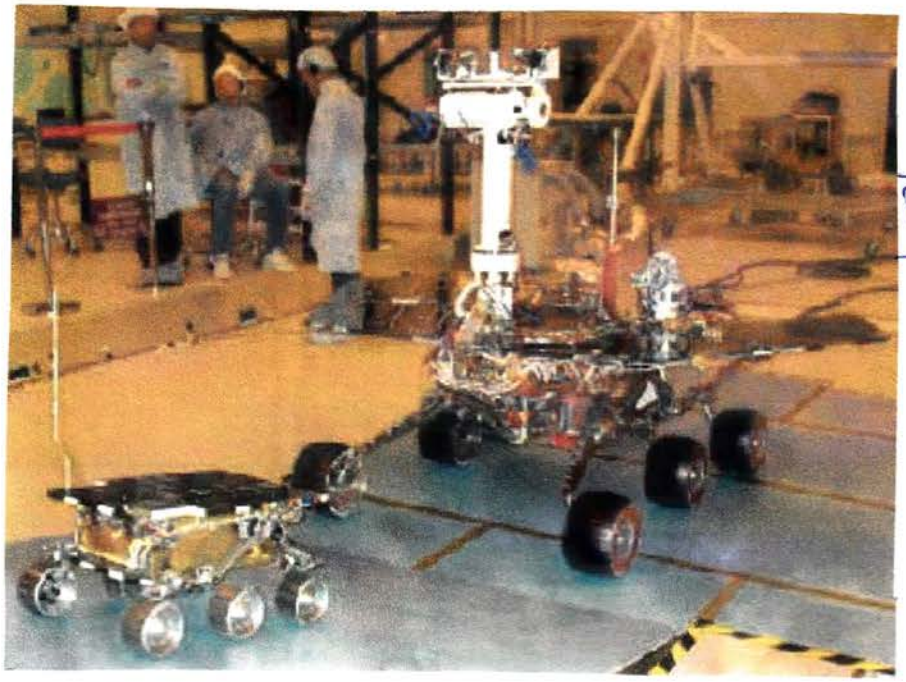

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NASA/JPL NEWS RELEASE : 14 NOVEMBER 2002.

MARS ROVER TAKES BABY STEPS.

Like any travelers worth their frequent flyer miles, the twin rovers of the Mars Exploration Rover Mission must prepare for a long journey. Unlike airline passengers, however, the rovers won't have an attentive flight crew to tend to their needs. Instead, the twins face a daunting 460 million kilometer (286 million mile) voyage to Mars. To ensure their readiness, scientists and engineers at JPL are testing the rovers by simulating conditions they'll experience en route to and upon arrival at the red planet. Just as the twins will travel separately, they are also tested separately. Rover 1 is midway through the process affectionately known as "shake and bake." Inside the cocoon formed by the spacecraft backshell and heatshield, the rover, in its cruise stage, was placed on a vibration table and shaken intensely. Such vigorous movement mimics the conditions the rovers will face leaving Earth's atmosphere and entering the martian atmosphere. The intense sound of launch can also pose a threat to spacecraft health. Rover 1 underwent acoustic testing to test its sensitivity to sound and passed with flying colors. JPL's Space Simulator Facility serves as an "oven" and a "freezer" for another round of the environmental testing. To reproduce conditions in space, Rover 1 will undergo solar thermal vacuum testing. In this large chamber, the spacecraft will be exposed to temperatures from -196 degrees Celsius (-320 degrees Fahrenheit) to 93 degrees Celsius (about 200 degrees Fahrenheit). The chamber's solar capabilities are known worldwide. "The solar thermal vacuum chamber can generate sunlight at 10 times the intensity of a clear, sunny southern California day," said Robert E. Brown, JPL facility engineer. Telecommunication equipment will also be tested for electromagnetic compatibility. Engineers must be sure that instruments onboard the rovers can freely transmit and receive data without interfering with one another. Rover 2 is now fully assembled and in its surface configuration - the way it will look when the petals of the lander open to free it to roam the surface of Mars. Recently, engineers successfully conducted a series of mobility tests on the floor of JPL's Spacecraft Assembly Facility.

Although several engineering models of the rovers had been driven, this marked the first time a flight vehicle had been tested for mobility. While systems engineers are readying the rovers for their expedition, the operations and science teams are preparing themselves for what promises to be a demanding schedule once the science phase of the mission begins. Although long-term goals for the rovers were set in the mission planning phase, day-to-day schedules will be determined by the conditions on the planet, as well as what was accomplished the prior day. "What makes the mission so different from anything we've done before is we're operating the rovers in a non-deterministic way," said John Callas, science manager of the Mars Exploration Rover Project. "We don't know what we'll do until we land and see what's there. Each day we'll command the rover based on what we have just learned. It's really an adventure that way." A team of approximately 100 people will support each rover during the science phase. Teams will work in shifts that will change daily by 40 minutes to accommodate the 24 hour, 40 minute martian day. The bulk of the team's work will be done while the rovers are "sleeping" - about 14 hours a day. Data from the rovers' day must be processed and interpreted. Based on those results, the team will build new commands for the rovers to complete when they wake up. To prepare for this, the team is participating in a series of training exercises. In thread tests, different types of software are checked for compatibility. Team members also attend "flight schools," lectures where they are instructed on specific subsystems or rover processes. The most elaborate of the exercises are the operational readiness tests, during which an exact engineering model of the rovers called the Surface System Testbed will be used in an indoor sandbox.

"These are essentially dress rehearsals," Callas said. "We'll do these tests on a flight-like timeline. If we have 14 hours, we have to get it all done in that timeframe. We'll be using flight tools and simulated data. We'll build products and commands and run them on the testbeds to make sure they work." With the frenzy of activity that occurs before and during the mission, it is vital for scientists and engineers to remain healthy, rested and focused. The team has participated in a series of fatigue counter-measure workshops that teach how to recognize and alleviate symptoms of sleep deprivation. "It's going to be tough because everyone's going to want to be there all the time; it's an exciting project - there are going to be new discoveries every day," said Callas. "However, some of those people need to be at home sleeping, preparing for their shift - part of my job is making sure they don't overdo it." The Mars Exploration Rover team members are responsible for every aspect of the rovers' journey. Their reward will come when they receive digital postcards from Mars, as the rovers give scientists - and the public - new views and more detailed information about the red planet.

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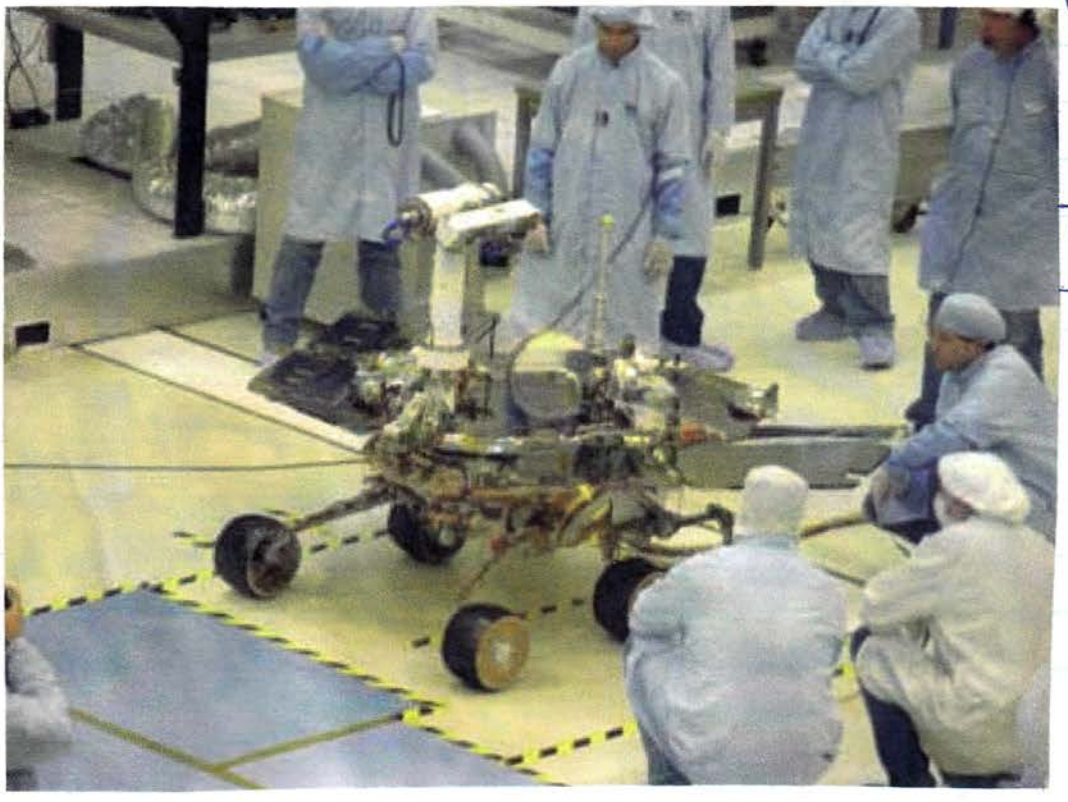

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SWEEPS WEEK

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NASA Web masters are already bracing for January 2004, when twin Mars Exploration Rovers are scheduled to be up and running across the surface of the red planet. Orlando Figueroa, director of the Mars Exploration Program at NASA headquarters, says experts predict Webcasts of the rover imagery will far surpass the number of Internet hits generated by Mars Pathfinder in July 1997. Between July 1 and Aug. 4 of that year, the 20 Pathfinder mirror sites logged 565 million hits. On July 8, as word of the Pathfinder Webcasts spread, 47 million viewers checked the sites. If the new rovers perform as advertised, NASA Web-heads expect to get even more business. Keeping the sites running at that level for the planned 90-day minimum duration of the mission will be a real challenge, Figueroa says, arguing that the expected interest highlights the importance of exotic imagery in generating public support for space exploration.

ROVING TOWARD FLORIDA

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NASA's two Mars Exploration Rovers (MERs) are scheduled to arrive at Cape Canaveral in January for final test, assembly and checkout in preparation for the first rover's launch about May 30. Both will fly on Boeing Delta IIs, with the second MER set for launch June 24. The rovers have been completing mobility tests at the Jet Propulsion Laboratory (MER-2 is shown), and MER-2 is in the midst of its critical "surface thermal vacuum test" where rover systems are powered up in Martian temperature and pressure conditions. In late November, MER Athena science team members made what they hope will be the final design change, when they "gave their Rats [Rock Abrasion Tools] some teeth." The program has been debating for months what type of grinding head the Rats should have to chew away at Martian rocks. Researchers do not know exactly how hard Martian rocks will be, and they must design a tiny grinding head that will work against the hardest rocks possible. Testing suggested a design using hard resin with lots of fine diamond grit mixed in would have the best capability. The decision was picked in part because it is "self sharpening"—as the resin on the cutting head wears away, it will continually expose new diamond grit to the rock being cut.

AWST: 23-12-'02

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An offspring of FIDO (Field Integrated Design and Operations) called K9 has begun playing in this "Marscape" test facility at NASA's Ames Research Center in preparation for a future mission to Mars. Jointly developed by Ames and the Jet Propulsion Laboratory, which gave birth to FIDO four years ago, K9 is a six-wheel, 63-in.-high, solar-powered rover that weighs 145 lb.

With avionics, instrumentation and autonomy software developed at Ames, K9 carries a variety of instruments for exploring the Martian surface, including a compass, inertial measurement unit and three pairs of monochromatic cameras used for navigation and instrument placement.

It also includes a pair of high-resolution color stereo cameras and an arm-mounted, focusable microscopic camera developed by the University of Colorado at Boulder, called Champ. The stereo cameras create a 3D virtual map of the exploration site that scientists use to guide K9 to its target.

The $74,000 Martian field covers 0.75 acres and includes geological features that resemble the terrain of the planet, including a dry lake bed, an outflow channel, volcanic zone with a dry hydrothermal spring, meteorite impact crater and so-called chaotic terrain.

Computer engineer Maria Bualat, who leads the K9 project, said the goal is to integrate and demonstrate new robotic technologies for future Mars missions. By using planning and scheduling software, scientists hope to cut the amount of time spent in directing a rover's exploration. Mars' distance from Earth means it takes three Martian days to complete the process of directing a rover. The goal is to cut that to one day.

"What's unique about this software being developed at Ames is that it generates contingency plans to provide an alternative that can be executed when things go wrong," by giving the robot alternatives, said computer scientist David Smith. "By having options available, you increase the science return."

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AWST: 23-12-2002.

FLORIDA TODAY : 24 DECEMBER 2002.

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NASA SPONSORS CONTEST FOR KIDS TO NAME MARS ROVERS BY JAN. 31.

CAPE CANAVERAL - The twin rovers that will launch from Cape Canaveral next summer and ramble across Mars in early 2004 are yet to be named. Right now, they're known by the droll monikers "Mars Exploration Rovers" -- or MER-A and MER-B. There's still time to fix that, and NASA is collaborating with the Planetary Society and LEGO Co. to get schoolchildren involved in a contest to name the two robotic explorers. "We really want students to think about the idea of exploration, adventure and enterprise," said Jeff James, senior producer at LEGO Direct, which has a Web site (http://www.lego.com/rovers/) to coordinate the competition. Kids can submit entries until Jan. 31, 2003. NASA plans to announce the winners before the first launch, set for May 30. To enter, students must be 5 to 18 years old and attending a U.S. school. Students should name both rovers and include a 50-500 word essay, depending on their age group, about why their names should be picked. The contest began in early November, and already, LEGO has received more than 2,500 entries. They hope to receive tens of thousands by the deadline. Twelve-year-old Valerie Ambroise helped name the Sojourner rover -- the last robotic vehicle to land on Mars -- in 1997. She wrote an essay about Sojourner Truth. Sojourner also means "wanderer," so the name had a double meaning that judges liked. She was picked from thousands of entries. "That whole program was so successful and became so obvious that students wanted to have a role in the whole process," said Dave Lavery, programming executive for solar system exploration at NASA headquarters in Washington. "They were wonderfully creative in some of the suggestions." To stand out, the experts offer some advice for students: be creative and do a lot of research. The rover contest Web site offers another hint: "Space objects, missions, and spacecraft have traditionally been named after people or places from history, mythology, or fiction, or with words that convey a spirit of exploration or enterprise." James and Lavery suggested looking to other cultures, perhaps Norse or South American, for inspiration. Other Mars spacecraft have had names like Mariner, Viking, Odyssey, Global Surveyor, Sojourner and Pathfinder. "A lot of the characters from NASA really kind of personify great ideals," James said. One other example of school kids getting into the act was when the first President George Bush let school kids have a contest to name the youngest of the shuttles. It turned out to be Endeavour, which was a name borrowed from the first ship commanded by James Cook, an 18th century British explorer, navigator and astronomer. The child who wins the rover contest will get to bring his or her family to Cape Canaveral Air Force Station for the first launch in May. LEGO workers have been busy building their own version of the rovers out of LEGO bricks. Five master builders in Denmark spent 650 hours building a life-size replica of one of the Mars rovers. It took 90,000 LEGOs. They showed off their 300-pound work at the World Space Congress in October.

22221

SPACE.COM : 10 JANUARI 2003.

MARS ROVER PLANNERS IN TIME CRUNCH TO PREPARE SPACECRAFT, SELECT LANDING SITES.

ARCADIA - Engineers and scientists working on the NASA Mars Exploration Rover (MER) project are in the final stages of readying the twin robots for launch and picking safe and scientifically rewarding landing sites on the red planet. The road to Mars for the MER program has not been easy. A number of technical challenges -- such as designing, testing and qualifying airbag and parachute systems, in particular -- dogged the project, requiring extra time, money and talent. Meanwhile, during the past two years, Mars scientists have mulled over some 185 landing sites. They have debated the merits of each, and continue to wrestle with a matrix of maddening worries -- from high winds, dust, swings of day/night temperatures to dangerous rocks that might cripple chances for successfully landing and operating the robots. At the 4th 2003 Mars Exploration Rover Landing Site Selection Workshop being held here this week, hardware and high hopes are on the table as the countdown to launch draws inexorably closer. First and foremost Where on Mars the robots will bounce to full stop still is under discussion. Four landing locales have been culled from a huge list of promising sites. They are Terra Meridiani, often called the Hematite site (and soon to be named Meridiani Planum), Gusev Crater, Isidis Basin and a "wind safe" site in Elysium. Each has its merits. Each has its drawbacks. "First and foremost, of course, is the fact that if you don't land safely you don't get any science back," said John Grant, co-chair of the Landing Site Steering Committee. Grant is based at the Smithsonian Institution's Center for Earth and Planetary Studies at the National Air and Space Museum in Washington, D.C. "The sites that we're looking at now are undoubtedly the best studied locations on the surface of Mars, I would argue," Grant said. Furthermore, those landing spots were whittled down on the basis of science, said Matt Golombek, also a co-chair of the Landing Site Steering Committee, based at the Jet Propulsion Laboratory (JPL) in neighboring Pasadena, Calif. "This is in fact the first time that site selection has used science to triage landing sites on Mars," Golombek said. Picking the right site Those landing locations are on the table because they address the science objectives of the rover missions: Determine if water was present on Mars and whether there are conditions favorable to the preservation of evidence for ancient life Elysium likely contains ancient terrain, which may hold clues to Mars' early climate when conditions may have been wetter. The three other sites show evidence for surface processes involving water. Each wheeled rover carries the Athena package of science gear. That array of equipment has undergone rigorous calibration and testing, said Steve Squyres, principal investigator for the science payload at Cornell University in Ithaca, New York. Matching Athena's performance to the right site to maximize scientific output and achieve testing of scientific hypotheses is crucial. "What you do here not only benefits the selection process, but it will directly impact operation of the rovers," Squyres told the gathered group of scientists. "We've got to run the last lap of this race...and getting the details right is essential," he said.

Deliberations regarding the sites are keyed to hammering out final landing area recommendations to be given to NASA space science chief, Edward Weiler. He will make the final determination of MER landing sites in early April. It is clear that time is short at hand. The launch window for the first rover opens May 30, 2003, and the second rover's launch period begins June 25, 2003. Touchdown of the first rover on Mars is Jan. 4, 2004, followed by the second robot arriving on Jan. 25, 2004. Each rover will have a primary mission lasting at least three months on the martian surface. Phased shipping of mission hardware to the launch site in Florida begins this month, said JPL's Rob Manning, the MER Entry, Descent and Landing Operations Manager. Manning served similar duty for the Mars Pathfinder/Sojourner rover mission that touched down on the red planet in July 1997. "For MER, 2002 was a very, very intense year," Manning told SPACE.com. "The project was less than three years from start to launch. We had to do so much over again. So many parts of the system we had to go back and reengineer for this larger mass vehicle." "We did far more testing on this project than we did on Pathfinder...and we thought we did a lot then," Manning said. Bounce to the ounce For instance, the huge gaggle of airbags that cocoons each rover during hard landing has been drop tested some 50 times. Early tests proved worrisome. So much so that significant beefing up of the airbags was necessary. Similarly, there were a number of ill-fated tests of the MER parachute system. That too demanded considerable extra work to iron out a mission trouble spot. What are the drivers for mission success? "Very simply it's how fast you hit, what you hit, how you bounce, and how long you live after you survive all of that," said Mark Adler, JPL's Project Landing Site Engineer for MER. "The first bounce isn't the last bounce. This is a very robust system. But there is one annoying feature. It lands more than once. And in fact, it lands many times," Adler said. Mother Nature's artifacts For Jim Garvin, NASA Lead Scientist for Mars Exploration, MER is the first real taste of the surface. The twin rovers armed with the Athena science payload will calibrate the whole community on what Mars is truly like. "I like to call rocks 'Mother Nature's artifacts.' They hold the stories. They don't lie. But you've got to get to them. Until we get to those rocks and train people to understand them and move amidst them... touch them and taste them... coupled to the remote sensing as to what is really happening on the surface of Mars, well, it is always going to be a bit of a crap shoot. We get it wrong even here on Earth." Given the two Viking landers and Mars Pathfinder/Sojourner, scientists know a little about three spots on Mars. "And we're still confused about those," he added. "I think what MER will give us is far less confusion about two very different types of sites. MER can't miss if it lands and its great instruments get to touch anything."

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Wissenschaft

NASA schickt zwei Roboter zum Mars

Die NASA bereitet derzeit zwei baugleiche Roboterfahrzeuge für die Reise zum Mars vor.

Die sechsrädrigen Wagen sollen dort vor allem nach Hinweisen auf Wasser im Boden suchen und der Frage nachgehen, ob auf dem Planeten einst Leben möglich war. Die Starts der neuen 181 kg schweren Roboter sind für Mai und Juni geplant. Sie sollen 2004 auf dem Roten Planeten landen und dort 90 Tage unterwegs sein.

Mit Kosten in Höhe von 800 Mio. Dollar ist dies die zweitteuerste Mission der NASA bei der Erforschung des Mars.

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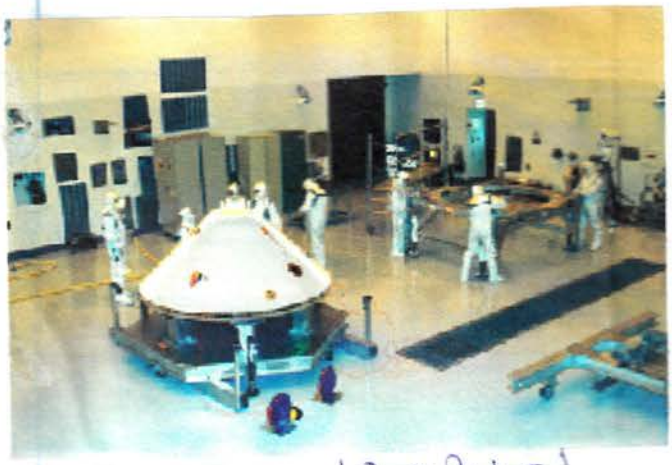

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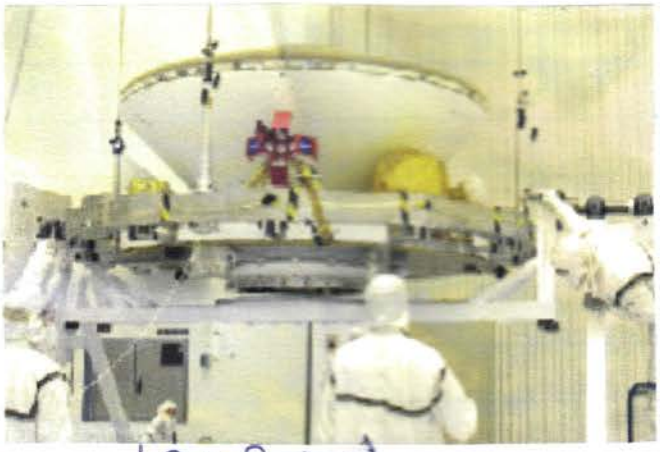

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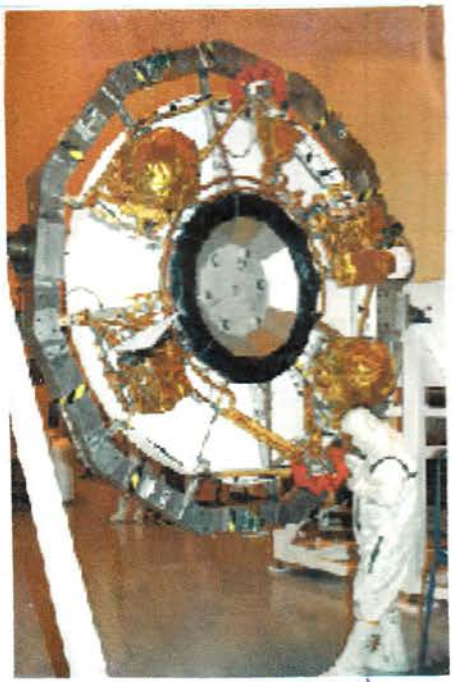

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FLORIDA TODAY : 23 JANUARI 2003.

SCIENTISTS PICK SITES FOR MARS LANDINGS.

CAPE CANAVERAL - The science team for the Mars Exploration Rovers, set to launch from here in May and June, approved two recommended landing sites this week. Gusev Crater and an area called Terra Meridiani were deemed the top two places for accomplishing the mission's scientific goals after a series of open meetings, the last of which occurred two weeks ago. Scientists hope the sites hold clues to Mars' water mystery. "If you think about the landing site selection on Mars, it's really the first time that science is really being used to direct landing site selection," said Matt Golombek, the landing site scientist for the Mars Exploration Program. Those picks still have to pass several more rounds of scrutiny. A panel of experts will review the sites and make its recommendation to NASA headquarters in March. Ed Weiler, NASA's associate administrator for space science, will make the final call in April. NASA stands a mere four months away from launching the next pair of Mars rovers. The agency has to do a lot of work between now and May 30 to get the first of two identical rovers into space. Now that the science community has weighed in, the engineers will have their say. "Safety is, of course without question, the dominant concern for landing sites," Golombek said. "That's $400 million worth of spacecraft nobody wants to risk. If it doesn't land safely, you're not going to get any science." Here's what the engineers will be examining in the coming weeks: Horizontal winds and turbulence in atmosphere above the landing sites, Rocks and how many you'll have to cushion the rovers from And the region's slopes. The rovers will be surrounded by airbags on their descent through the thin atmosphere. Once they hit the surface, they will bounce a little more than half a mile. To put it mildly, a cliff in the bounce zone would be bad. Currently, a computer simulation is running and will predict how the rovers will enter the atmosphere and bounce once they hit the ground. Early reports indicate Terra Meridiani may be the safest site out of the top four because of its flatness and low wind. But Gusev isn't second. It looks like it may have higher winds, which would be a problem for a spacecraft trying to slow down during its parachute-aided descent, and also a rougher surface. A place called Elysium might snag the runner-up spot for safety. Meridiani, also known as the Hematite site, lies on a boundary between highland and lowland areas. NASA's past three successful landers have all been in the northern lowland plains. Meridiani would provide a glimpse into a completely different part of Mars. It has less dust than other sites and also appears to have hematite in the region. This mineral may be a marker of past water. Gusev Crater appears to have been filled with water at some point. A channel leads into the crater. Elysium seems to have ancient terrain, which could clue in scientists as to Mars' past climate. "I think in their own mind, they have it prioritized, but anything could happen," said Mary Hardin, spokeswoman at the Jet Propulsion Laboratory in Pasadena, Calif. Mars Global Surveyor and Mars Odyssey continue to orbit the Red Planet and scout out potential sites. The rovers are still at NASA's Jet Propulsion Laboratory. Parts of the spacecraft will ship to the Florida spaceport during the next few days. These include the shell, heat shield and the section that will contain the engine that will boost the rovers out of Earth orbit and on toward Mars. The first rover, temporarily known as MER-A, will be shipped to the Cape in mid-February. Each will ride separately on Delta 2 rockets from Cape Canaveral Air Force Station. The rovers also have to be properly named. NASA and LEGO are sponsoring a contest for students to name the rovers. The deadline is Jan. 31. "It is the most exciting time on Mars," Golombek said. "without question."

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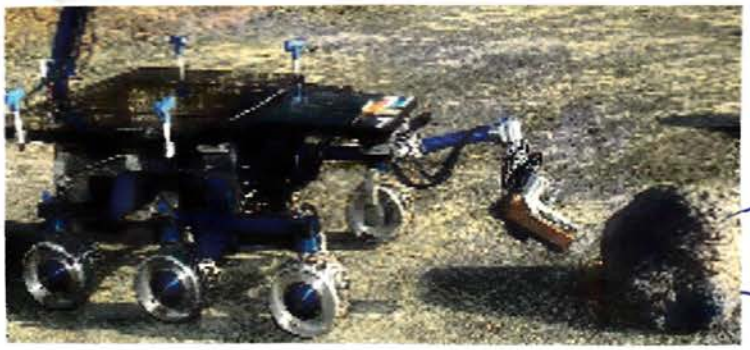

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
February 5, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: May 30/June 25
LAUNCH TIMES: 2:28 p.m./12:34 a.m.

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The cruise stage, aeroshell and lander for the MER-2 missionarrived at the KSC Payload Hazardous Servicing Facility (PHSF) at 4 p.m. on Monday, Jan. 27. The lander was unpacked, cleaned and placed in the high bay on Tuesday. The aeroshell and cruise stage were removed from the shipping container today. The identical MER-1 flight hardware will arrive in mid-February. The first of the two Mars Exploration rovers will arrive at KSC in late February and early March.

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
February 19, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: May 30/June 25
LAUNCH TIMES: 2:28 p.m./12:34 a.m.

The cruise stage, aeroshell and lander for the MER-2 mission arrived at the KSC Payload Hazardous Servicing Facility (PHSF) on Monday, Jan. 27. The identical flight hardware for MER-1 and the first of the two Mars Exploration rovers will arrive at KSC on Monday, Feb. 24. The second rover will arrive the second week of March.

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KSC PRESS RELEASE : 24 FEBRUARI 2003.

FIRST MARS EXPLORATION ROVER ARRIVES AT KSC TO BEGIN PREPARATION FOR LAUNCH

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The first of two Mars Exploration Rovers, MER-2 arrived at the Kennedy Space Center today from the Jet Propulsion Laboratory in Pasadena, Calif. Thecruise stage, aeroshell and lander for the Mars Exploration Rover-1 mission also arrived today. This same flight hardware for the MER-2 rover arrived January 27, however this rover is scheduled to arrive at KSC around March10.The Boeing Delta II vehicle for the first launch of the two launches scheduled on May 25 is planned for erection on the pad at Space Launch Complex 17 beginning April 18. The Delta for the second launch on June 30 will begin erection activities on May 1. Each spacecraft will receive a MER-A or MER-B designation once they arrive at the pad.While at KSC, each of the two rovers, the aeroshells and the landers will undergo a full mission simulation. All of these flight elements will then be integrated together. After spin balance testing, each spacecraft will be mated to a solid propellant upper stage booster that will propel thespacecraft out of Earth orbit. Approximately ten days before launch they will be transported to the launch pad for mating with their respective Boeing Delta II rockets.The rovers will serve as robotic geologists to seek answers about the evolution of Mars, particularly for a history of water.

REUTERS : 26 FEBRUARI 2003

NASA STARTS COUNTDOWN TO MARS MISSION.

80821

CANBERRA - Astronomers have started a countdown to the launch of two robotic buggies on a mission to find out if there is, or ever was, life on Mars. Charles Elachi, director of the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory, said final preparations were underway with one "exploration rove" arriving at Cape Canaveral this week and the second due in three weeks. He said the rovers, which are the size of an office desk, were set to be launched on May 30 and June 25, piggy-backing on two rockets then parachuting down to Mars in January in an air-bag cushioned landing. Elachi said there was strong interest in the latest launches after recent indications there could be water ice on the red planet. Interest was also keen after the loss in 1999 of two robotic Mars missions -- a lander and an orbiting spacecraft -- at a cost of $290 million. Missions to Mars can only occur every two years when the planets are in the favorable alignment. Liquid water is seen as key for Earth-type life on a planet and underground water ice could help show how Mars developed. "Interest in Mars has really heated up since indications of water raised the question again about whether life has evolved there," Elachi told Reuters in an interview while in Australia to visit one of three tracking stations involved in the mission. He said NASA's robotic explorations, based at the Jet Propulsion Lab in Pasadena, had not been affected by this month's shuttle Columbia disaster. Elachi said three years of work had gone into the latest Mars mission at a cost of $800 million and scientists hoped to repeat the success of 1997's Mars Pathfinder mission, the first moveable buggy to land on Mars. The new rovers can travel farther than Pathfinder, up to one km (0.6 miles), to relay information about rocks and surface moisture directly back to three centers worldwide -- in California in the Unites States, at Tidbinbilla near the Australian capital Canberra, and Madrid in Spain. Each rover is equipped with a mast-mounted camera providing 360 degree, stereoscopic, views of the cold, rocky terrain and has a robotic arm that can put instruments against rock and soil. Elachi said the latest solar-powered robotic landers would be able to transmit information about Mars for between 90-120 days once they arrived, depending on amounts of sunlight. Once winter hit Mars, with temperatures plummeting to minus 150 degrees Centigrade, the rovers would run out of energy. Elachi said NASA would decide in April which of four landing sites to use on Mars, using images and data from two other NASA spacecraft currently orbiting Mars -- Mars Global Surveyor and Mars Odyssey. Mars is one of the most studied objects in our solar system. As Earth's next-door planetary neighbor, it has the advantage of location and is thought to be similar in composition to our planet.

SPACE.COM : 27 FEBRUARI 2003.

First of Two Mars Rovers Arrives at Cape

One of the two Mars Exploration Rovers, this one dubbed MER-2, arrived at the Kennedy Space Center this week from the Jet Propulsion Laboratory in Pasadena, Calif. The cruise stage, aeroshell and lander for the Mars Exploration Rover-1 mission also arrived. The first launch is scheduled for May 25 aboard a Boeing Delta II rocket. The second launch is slated for June 30. Meanwhile, the craft will undergo mission simulation, then the pieces will be put together and tested further. The rovers will serve as robotic geologists to seek answers about the evolution of Mars, particularly for a history of water.

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
February 27, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B, Cape Canaveral Air Force Station
LAUNCH DATES: May 30/June 25
LAUNCH TIMES: 2:28 p.m./12:34 a.m.

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The first of two Mars Exploration Rovers, MER-2, arrived at the Kennedy Space Center on Monday from the Jet Propulsion Laboratory in Pasadena, Calif. The cruise stage, aeroshell and lander for the Mars Exploration Rover-1 mission also arrived with it. This same flight hardware for the MER-2 rover arrived Jan. 27. However, this rover is scheduled to arrive at KSC around March 10. The Boeing Delta II vehicle for the first of the two launches, scheduled on May 30, is planned for erection on the pad at Space Launch Complex 17 beginning April 18. The Delta for the second launch on June 25 will begin erection activities on May 1. While at KSC, each of the two rovers, the aeroshells and the landers will undergo a full mission simulation. All of these flight elements will then be integrated together. After spin balance testing, each spacecraft will be mated to a solid propellant upper stage booster that will propel the spacecraft out of Earth orbit. Approximately ten days before launch, they will be transported to the launch pad for mating with their respective Boeing Delta II rockets.The rovers will serve as robotic geologists to seek answers about the evolution of Mars, particularly for a history of water.

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
March 5, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: May 30/June 25
LAUNCH TIMES: 2:28 p.m. / 12:34 a.m. EDT

At Kennedy Space Center, the first of two Mars Exploration Rovers, MER-2 has begun its prelaunch testing in the Payload Hazardous Servicing Facility (PHSF). Processing of the MER-1 cruise stage, lander, aersoshell and heat shield is also underway. A functional test of the MER-2 rover systems will be conducted on Mar. 6 and Mar. 9. The MER-1 rover is scheduled to arrive at KSC on March 11. Once functional testing and mission simulation of the flight elements is complete, they will be integrated together. Each spacecraft will be mated to a solid propellant upper stage booster that will propel the spacecraft out of Earth orbit. After mating to the upper stage, the stack will undergo spin balance testing. Approximately ten days before launch the payload will be transported to the launch pad for mating with their respective Boeing Delta II rockets. The Boeing Delta II vehicle for the first launch of the two launches scheduled on May 30 is planned for erection on Pad 17-A at Space Launch Complex 17 beginning April 18. The Delta for the second launch on June 25 will begin erection activities on May 1 on Pad 17-B.

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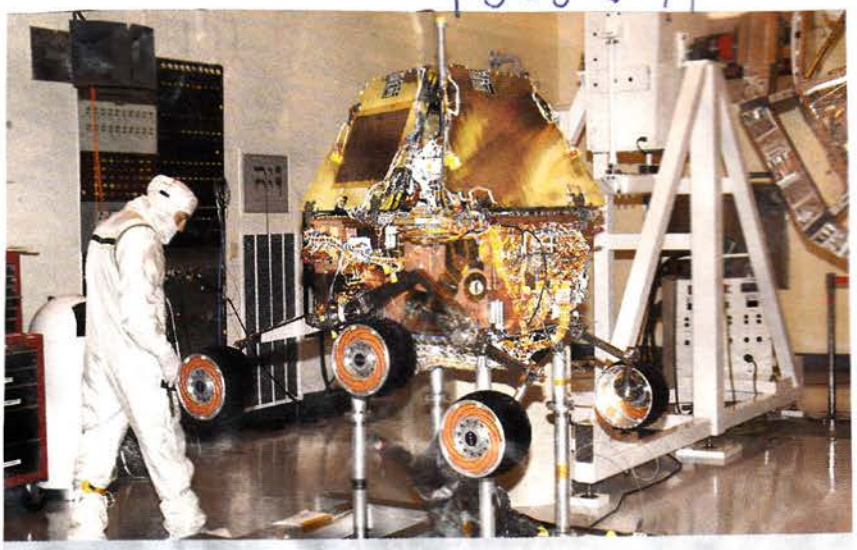

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Mars Exploration Rover Readied for Late-May Launch

The first Mars Exploration Rover (MER) has arrived at the Kennedy Space Center in Florida and is being processed for a May 30 launch on a Boeing Delta II rocket (see photo). The Jet Propulsion Laboratory in California is leading the MER project, which involves sending two rovers separately to Mars for arrival on Jan. 4 and 25, 2004.

The 90-120-day surface missions may cover up to 1 km. (0.6 mi.) each, with the rovers acting as very slow-moving field geologists searching primarily for evidence of past water and suitability for life (*AW&ST* Dec. 11, 2000, p. 68). JPL was completing tests of the second MER last week and plans to ship it to Kennedy this week for a June 25 launch.

The first rover arrived at Kennedy on Feb. 24. This is one month later than the January arrival date that was projected last December (*AW&ST* Dec. 23, 2002, p. 19). The decision to proceed with the MER project was made in 2000, which has forced a tight schedule. Software is providing the usual surprises and anxiety, and engineers are continuing to try to fix problems that appear in testing. Despite the slip, project officials believe there is enough margin in the schedule to make the mid-year launch window. The 2003 planetary alignment is unusually good for a rover mission and conditions will not be repeated soon.

AWST: 10-03-2003

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
March 19, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: May 30/June 25
LAUNCH TIMES: 2:28 p.m. / 12:34 a.m. EDT

Final build-up of the two rovers is going well. A second functional test and mission simulation for MER-2 is scheduled to occur beginning tomorrow and last through the weekend. The initial functional test and mission simulation for MER-1 is planned for the last week of March. Processing of the cruise stage, lander and heat shield elements continues. The flight battery installation is complete. Once functional testing and mission simulation of the flight elements is complete, they will be integrated together. Each spacecraft will be mated to a solid propellant upper stage booster that will propel the spacecraft out of Earth orbit. After mating to the upper stage, the stack will undergo spin balance testing. Approximately ten days before launch the payload will be transported to the launch pad for mating with their respective Boeing Delta II rockets. The Boeing Delta II vehicle for the first launch of the two launches scheduled on May 30 is planned for erection on Pad 17-A at Space Launch Complex 17 beginning April 18. The Boeing and NASA review to assess readiness of the vehicle and the launch pad for the MER-A mission is underway today at the Boeing plant in Huntington Beach, Calif. The Delta for the second launch on June 25 will begin its erection at Pad 17-B on May 1. Boeing's Delta II Heavy Design Certification Review for MER-B is scheduled for tomorrow, Mar. 20.

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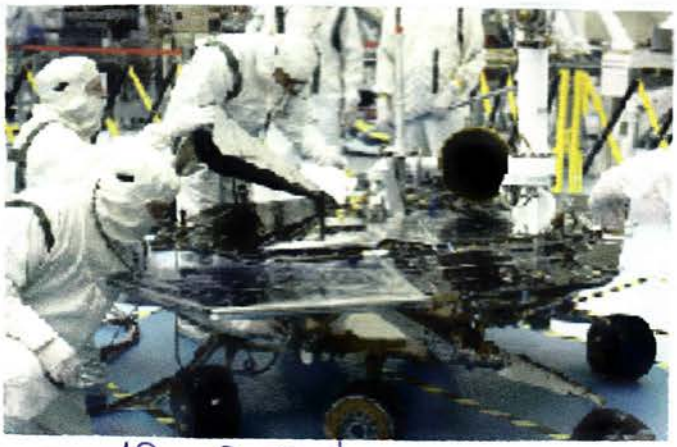

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FLORIDA TODAY : 21 MAART 2003.

ROVERS GET READY FOR SPRING LAUNCH.

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CAPE CANAVERAL - The past couple months have been grim for the nation's space agency after the loss of shuttle Columbia. This spring, some engineers and scientists hope to give the agency something to hope for. The first of twin Mars Exploration Rovers will launch from Cape Canaveral Air Force Station as early as May 30. The second will launch June 25. "The agency and the country need some really good news in space right now, and I feel like it's my job to give it to them," said Steve Squyres, the Mars Exploration Rovers' lead scientist. But doing so won't be easy. The last time NASA tried to send a lander to the red planet -- in 1999 -- the probe crashed. A Mars orbiter failed that same year. "It's been mentioned once or twice," said project manager Pete Theisinger. "Surface missions to Mars are by themselves energizing." The 2001 Mars Odyssey successfully made it into orbit without a hitch two years after the failed Mars missions. "JPL has put the best team on this project that I've seen in 25 years," Squyres said. The mission is projected to cost $800 million. Shortly after arriving at Kennedy Space Center, the second of two rovers bound for Mars this summer is undergoing tests. Next week, one of the rovers will go through a mission simulation: it will unfold the petals on its lander, which would normally allow the rover to crawl onto the Martian surface. In a KSC hangar, the rover's solar arrays will flip open, and a camera on top of a tall mast will take a look around the room. In addition to a grueling schedule to get the rovers ready in time, mission managers have another potential battle in the coming months. Each rover will carry small amounts of radioactive plutonium, cobalt and curium to power the science instruments and warm the rover's battery and electronics. This has raised the antennas of anti-nuclear activists. "We really don't see them as a safety hazard," said Theisinger. This year is a particularly good year for a lander to get to Mars because of the way the planets are aligned. Communication distance between Earth and Mars is short, and the angle of sunlight on Mars will make for good solar power.

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FLORIDA TODAY : 27 MAART 2003.

MARS ROVER LAUNCH DELAYED THREE DAYS.

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CAPE CANAVERAL - The launch of the summer's first Mars rover mission has been pushed back by at least three days to allow more time for engineering reviews. The Mars Exploration Rover-A was slated for a June 5 launch from Cape Canaveral Air Force Station. Now, NASA is looking at launching the spacecraft no earlier than June 8. "They want to put a little more schedule margin," said Kennedy Space Center spokesman George Diller. On Tuesday morning, workers moved the rover out to Pad 17A and hoisted it on top of its Delta 2 rocket. NASA Headquarters in Washington, D.C. will decide the rocket's final launch date on Monday. Of course, bad weather or technical glitches could further delay the mission. The rover can launch until June 19. The delay will not affect its Jan. 4 arrival at Mars. The second rover, known as Mars Exploration Rover-B, is still on schedule for a June 25 launch. NASA will announce more inspiring names for the robots the day before launch.

SPACE.COM : 04 APRIL 2003

DECISION EXPECTED NEXT WEEK ON MARS ROVER LANDING SITES.

80835

BOULDER, COLORADO - Dual Mars robots now being prepped at the Kennedy Space Center for launch will soon have places to go. A decision as to where NASA's two Mars Exploration Rovers (MER) will touch down on the red planet is slated for next week. The ultimate selection of landing zones for each of the twin rovers falls to Edward Weiler, NASA's Associate Administrator for Space Science. Briefings on four candidate spots are now scheduled for April 10 at NASA Headquarters in Washington, D.C. After the briefings, Weiler is expected to give his okay on the top two landing locales. Two separate rover liftoffs are slated from Cape Canaveral, Florida in May-July, with each robot making a scheduled stop on Mars in January 2004. Small spots, big targets After a lengthy process of culling through some 155 landing sites, the leading four Mars targets are: Meridiani Planum; Gusev crater; Isidis; and Elysium. "Never has so much data been applied to four small spots on Mars," said John Grant, co-chair of the Landing Site Steering Committee at the National Air and Space Museum's Center for Earth and Planetary studies. Viking, Mars Global Surveyor, and Mars Odyssey imagery have played critical roles in evaluating prospective landing targets, deemed not only good for science, but safe for landing, he said. "Data can be your best friend...but also your biggest curse," Grant admitted. For example, some sites were given "the kiss of death" because of tough to get to and rough terrain, high winds, or simply not enough science output. Grant spoke here April 3 at the University of Colorado's Center for Astrobiology. Scientists and engineers have wrestled with each Mars location. Both sites decided upon must be safe for the robots to land upon, as well as drive across. Each of the rovers is outfitted with the Athena payload of science instruments. "These are probably the best calibrated instruments flown to Mars," Grant said. Safe descent onto Mars' surface for each of the robots makes use of a parachute system and small rocket firings, leading to inflation of a huge set of airbags. The robots will come to a stop after bouncing repeatedly across Mars. "Given that safety requirements are met, then site selection is science driven," Grant said. "Lots of people wanted to go to places that just aren't safe," he said.

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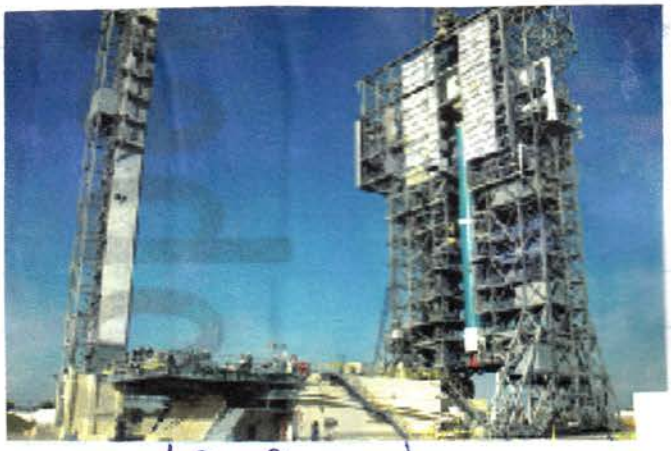

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FLORIDA TODAY : 14 APRIL 2003.

TEST PROMPTS MARS ROVER DELAY.

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CAPE CANAVERAL - The launch of the first of two Mars rovers has been delayed while NASA looks at a problem with cables connecting each spacecraft's main computer with its other parts. The cables to each stage of the spacecraft are severed, first from the cruise stage and then the lander stage, before the rover drives off on the surface of Mars. Testing showed a potential problem in how the spacecraft interprets signals once the cables are severed. The twin rovers will have to be taken apart at Kennedy Space Center for repairs, NASA said. The launch period for the first rover ends June 19; the second mission will launch 10 days or more after the first. The first launch, previously set for May 30, will go June 6 or later, NASA said Monday. The second is expected to fly as planned during its launch period of June 25 to July 15. Both will land on Mars in January 2004.

SPACE.COM : 11 APRIL 2003.

NASA SELECTS MARS ROVER LANDING SITES.

COLOARDO SPRINGS - In the Mars Exploration Rover (MER) landing site sweepstakes, the winners are: Meridiani Planum and Gusev crater. NASA has concluded that these two touchdown zones on Mars offer the greatest science reward for the soon-to-be launched dual Mars Exploration Rovers. Each MER robot will examine its landing site for geological evidence of past liquid water activity and past environmental conditions hospitable to life. Picking the two top sites follows a complex process of culling through some 155 prospective landing spots. The two sites are a giant crater that appears to have once held a lake, while the other is a broad outcropping of a mineral that usually forms in the presence of liquid water. "Landing on Mars is very difficult, and it's harder on some parts of the planet than others," said Ed Weiler, NASA associate administrator for space science in Washington, D.C. It was Weiler who called the shots -- as to where each of the robots would be targeted. "In choosing where to go, we need to balance science value with engineering safety considerations at the landing sites. The sites we have chosen provide such balance," Weiler said in a NASA press release. A longstanding leader of the pack of possible landing spots has been Terra Meridiani. This area is believed to contain a rich deposit of hematite. Here on Earth, hematite can collect in hot springs or in standing pools of water. This grayish mineral on Mars is thought to be indicative of ancient hot springs. "We have come amazingly far since Fall of 2000 when the plans for this effort unfolded," said James Garvin, NASA Mars Program Scientist. "Over the past 2-plus years, we have engaged the broadest possible cross-section of the science community in a 'crusade' to identify the most scientifically compelling, as well as 'science safe', landing sites for the MER rovers that are humanly possible," Garvin told SPACE.com . Eyes wide open Garvin said that today's announcement follows four landing site workshops. In addition, many human-years of effort have been put forth to understand the performance specifications of the MER landing system. That is, the difficult task of entry, descent, and landing followed by airbag roll stop, with each rover then wheeling away to begin their exploration. "There has clearly been more diligent effort applied to optimizing science against the risks of landing on Mars for the sites under consideration than ever before," Garvin said in pre-landing site decision remarks. "It is striking now, in retrospect, how little we had to go on for Viking and even Pathfinder. For MER, we are going to land with our 'eyes wide open' thanks to the rich legacy of new data from Mars Global Surveyor and Mars Odyssey, as well as the greater fidelity of simulation models of the MER landing system," Garvin said. On schedule The first rover, scheduled for launch May 30, will be targeted to land at Gusev Crater. The second, scheduled to rocket Marsward on June 25, will be precision-pointed to land at Meridiani Planum. Which rover is targeted to a specific site is still considered tentative, while further analyses and simulations are conducted. NASA can change the order as late as approximately one month after the launch of the first rover. The first mission will parachute to an airbag-cushioned landing on January 4, 2004, and the second on January 25, 2004.Once they reach their landing sites, each rover's prime mission will last at least 90 Martian days (92 Earth days). The rovers are solar-powered, and in approximately 90 days, dust slowly accumulating on their solar arrays likely will decrease rover power, bringing to a close each robot's sojourn.

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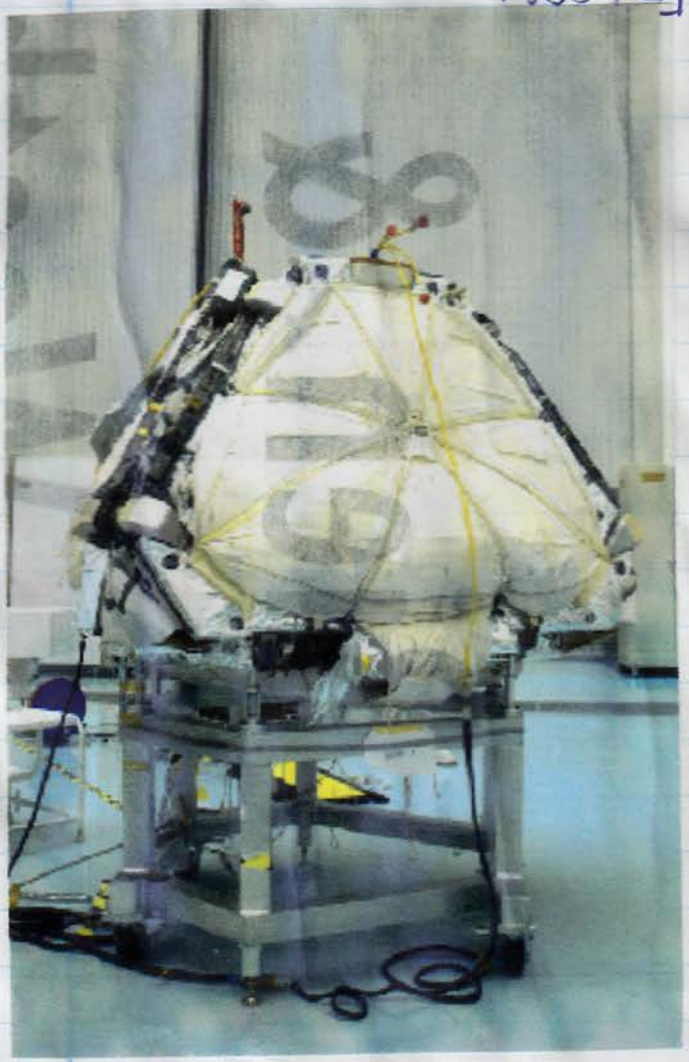

LANDING SITES NASA's "follow the water" mantra guided selection of the targeted landing sites for the two Mars Exploration Rovers (MERs) set for launch in June. If the complicated missions go as planned, the first MER to reach Mars will bounce to an airbag-protected landing on Jan. 4, 2004, at the Gusev Crater just south of the Martian equator. Three weeks later, on Jan. 25, the second rover is scheduled to land using the same technique halfway around the planet in the area known as Meridiani Planum. Because of the topography surrounding Gusev, including a dry "riverbed" that runs right into the crater, scientists believe it once held a liquid-water lake. The Meridiani zone has been found to be rich in gray hematite, which is usually produced where there is liquid water. Both sites hold the possibility of yielding data to the rovers' cameras and other instruments about the wet environment that may have once supported life on Mars. The sites were selected after a two-year scientific process of elimination, with the first lander off the pad to be aimed at Gusev. However, Meridiani is the prime scientific target, and that first rover can be retargeted there as much as a month after its scheduled June 6 launch. The flexibility was added in case there is a problem with the launch of the second rover, set for June 25.

AWST;
21-04-2003
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SPACE.COM : 14 APRIL 2003.

MARS ROVERS HIT SNAG : SOME DISASSEMBLY REQUIRED.

A potential problem has cropped up in readying the two Mars Exploration Rovers for sendoff to the red planet. A May 30 launch date for the first rover has been slipped until no earlier than June 6.According to a NASA statement, the concern regards cabling that connects the spacecraft's main computer, which is inside each rover, to peripherals in the cruise stage, lander and small deep space transponder. The connection to the cruise stage is severed during approach to Mars and the connection to the lander is severed before the rover drives off. Pre-launch testing revealed a potential problem in how the spacecraft interprets signals sent when the cables are severed. Both MER-A and MER-B will require fixing at the NASA Kennedy Space Center. The unanticipated problem is not expected to impact the launch period for the second rover takeoff, starting June 25 and closing July 15. However, the second mission cannot launch until 10 days after the first one. On Friday, NASA had announced that Meridiani Planum and Gusev crater were the two touchdown zones on Mars that the rovers would land. Researchers believe these two sites offer the greatest science reward for the rovers. Each MER robot will examine its landing site for geological evidence of past liquid water activity and past environmental conditions hospitable to life.

80844

SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
April 14, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: June 6/June 25
LAUNCH TIMES: 2:12:44 p.m. / 12:38:16 a.m. EDT

The beginning of the launch period for the first of NASA's two Mars Exploration Rover missions will be rescheduled until no earlier than June 6 to allow time to address a potential problem raised during pre-launch tests of the spacecraft over the weekend. The concern regards cabling that connects the spacecraft's main computer, which is inside the rover, to peripherals in the cruise stage, lander and small deep space transponder. The connection to the cruise stage is severed during approach to Mars and the connection to the lander is severed before the rover drives off. Pre-launch testing revealed a potential problem in how the spacecraft interprets signals sent when the cables are severed. The problem will require fixing on both rovers. The work is not expected to effect the launch period for the second rover mission which is scheduled to open June 25 and close July 15 for a landing Jan. 25, 2004. However, the second mission cannot launch until 10 days after the first one. The remedy will require some disassembly of the spacecraft at NASA's Kennedy Space Center, Cape Canaveral, Fla. The work cannot be done within the schedule of preparations for the original May 30 opening of the launch period. The mission will have two launch opportunities each day during the launch period, which is scheduled to close on June 19. Arrival at Mars is set for Jan. 4, 2003, regardless of launch date within that period. On Cape Canaveral Air Force Station, first and second stage processing activities for the MER-A vehicle continues in Hangar AO and erection on Pad 17-A is planned to begin April 22. Erection of the vehicle for MER-B is planned to begin May 24.

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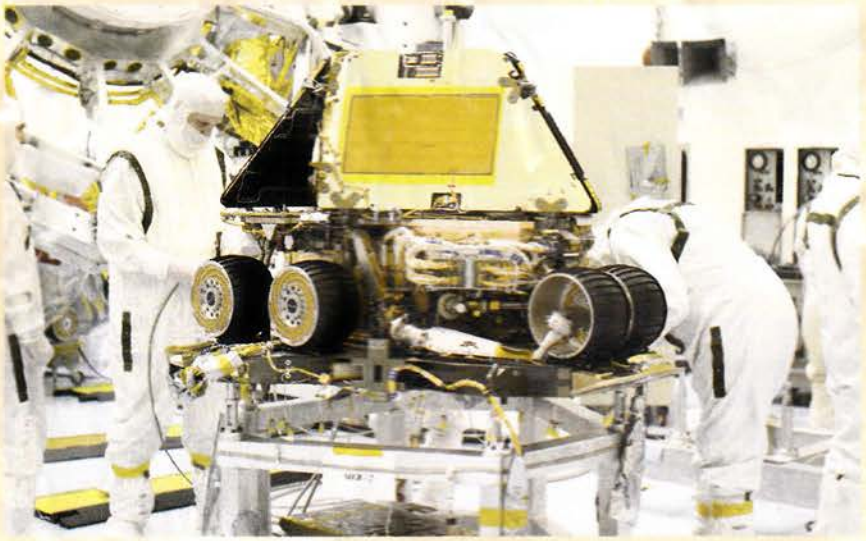
Launch of the first NASA Mars Exploration Rover will be delayed at least a week, to no earlier than June 6, to correct problems in cabling and a circuit board that links the spacecraft's main computer in the rover to the vehicle's cruise stage and landing system.

Partial disassembly of the rover is necessary to change the hardware, and this work will push launch—on a Delta II booster—of the first mission beyond the original date of May 30. The first of the two rovers must be launched no later than June 19. The second rover is to launch on a Delta with larger solid rocket motors between June 25 and July 15. Although the hardware issue also is being corrected on the second rover, its launch date has not changed.

NASA said the problem involves how the rover computers interpret signals sent to cut the cables when the lander system separates from the cruise stage in space near Mars, and how the cables separate when the rovers drive off the petal-shaped air-bag-equipped lander (see p. 17).

The first rover's trajectory to Mars will be adjusted so it still lands as planned next Jan. 4 at Gusev Crater, where a lake may have existed in ancient times.



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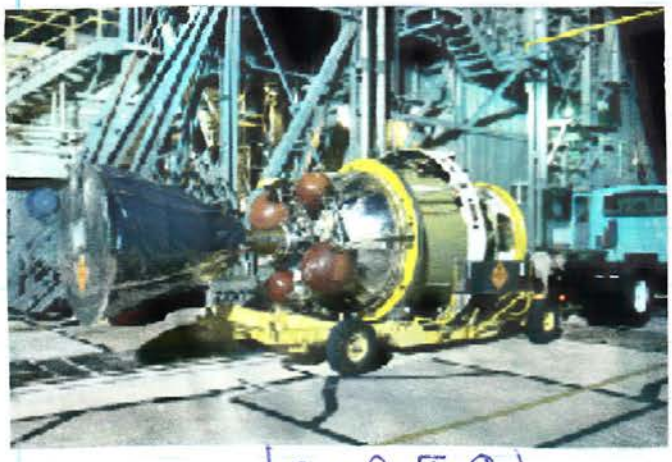
SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
April 25, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: June 5/June 25
LAUNCH TIMES: 2:56:59 p.m. / 12:38:16 a.m. EDT

80849

Good progress has been made in the circuit board rework and the reinstallation on the two Mars rovers. As a result, the launch of MER-A can be moved up by one day on the recovery schedule. Launch is now scheduled for Thursday, June 5. The first reworked telecom support board (TSB) arrived and was installed on MER-2 on April 16. Rover equipment deck (RED) was reinstalled on April 17. MER-2 lander integration was completed on Thursday, April 24. Integration of MER-2 entry vehicle (back shell, heat shield, lander and rover assembly) scheduled to continue through next week. On MER-1, the telecom support board (TSB) was installed on April 18. MER-1 rover and lander base petal final assembly was completed on Thursday, April 24. Rover installation on base petal is in work and scheduled to be completed by the end of next week. Lander air bag scheduled for installation by the end of next week. The mission will have two launch opportunities each day during the launch period, which is scheduled to close on June 19. Arrival at Mars is set for Jan. 4, 2003, regardless of launch date within that period. On Cape Canaveral Air Force Station, first stage and interstage were erected on Wednesday, April 23 for MER-A on Pad 17-A. Second stage erection is currently scheduled for Saturday, April 26 following with fairing installation on April 29. Simulated Flight and Engine Sequence is currently scheduled for May 9. The solid motor erection is scheduled for May 12-14.



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ASTRONOTES : 28 APRIL 2003.
REPAIRS TO MARS ROVERS GOING WELL.

NASA engineers have made "good progress" fixing glitches on two Mars Exploration Rovers (MERs), according to a statement from the space agency. The problems had forced a delay in the launch of the first rover from May 30 to no sooner than June 6. The beginning of that launch window has now been moved up to June 5, officials announced Friday. The window closes June 19. Arrival at Mars is set for Jan. 4, 2003, no matter when the craft goes up, so long as it occurs within the stated window. In early April, engineers said there were problems with cabling that connects each of the twin spacecraft's main computer to peripherals in the cruise stage, the lander and a deep space transponder. The work has focused on the computer circuit boards. On MER-A, the telecom support board (TSB) was installed on April 18. Meanwhile, other aspects of the mission are coming together. MER-A's rover and lander-base petal assembly was completed last Thursday. The rover is expected to be installed on the base petal by the end of this week, and its lander air bag should be in place, too. At the Cape Canaveral Air Force Station, MER-A's rocket is being assembled at Pad 17-A. Simulated flight and engine sequence testing is slated for May 9. When the electrical problem was first detected, officials said it would not impact the launch period for the second rover, which runs June 25 to July 15. The second mission can't launch until 10 days after the first one, however.

[80852]

SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
May 5, 2003

MISSION: Mars Exploration Rovers (MER-1/MER-2)
LAUNCH VEHICLES: Delta II/Delta II Heavy
LAUNCH PADS: 17-A/17-B
LAUNCH DATES: June 5/June 25
LAUNCH TIMES: 2:56:59 p.m. / 12:38:16 a.m. EDT

[80853]

The reworked telecom support boards (TSB) have been installed on both MER landers. MER-2 lander integration was completed on Thursday, April 24. Integration of the MER-2 entry vehicle (back shell, heat shield, lander and rover assembly) has been completed. Last week the spacecraft had a weight and center of gravity determination was followed by a dry-spin test. Fueling is planned for May 11 and will be followed by another spin test once fuel is aboard. On MER-1, rover installation onto the base petal has been completed and the lander's air bag installation is scheduled for this week. The mission will have two launch opportunities each day during the launch period, which is scheduled to close on June 19. Arrival at Mars is set for Jan 4, 2003, regardless of the launch date within that period.
On Cape Canaveral Air Force Station, first stage was erected on Wednesday, April 23 for MER-A on Pad 17-A. Second stage erection was completed on Monday, April 28. Fairing on April 30 Simulated Flight and Engine Sequence is currently scheduled for May 9. The solid motor erection is scheduled for May 14-16. For MER-B on Pad 17-B, the solid rocket boosters will be erected May 19-24, the second stage will be hoisted atop the first stage on May 28th.

BBC : 05 MEI 2003.

MARS MISSION AGREED.

[80854]

Nasa is planning to launch a Mars probe this summer The Russian and American space agencies have agreed to co-operate on a joint unmanned mission to Mars and expand the development of other joint interplanetary probes. The announcement came after talks in Moscow between the heads of the two agencies, Nasa administrator Sean O'Keefe and his Russian counterpart Yuri Koptev, about the International Space Station (ISS). Heads from the 16-nation group involved in building the ISS are to meet in September to decide on future development of the project. The issue of greater American funding for the space station was not discussed at the Moscow meeting, but the Russian space agency, Rosaviakosmos, is to receive a greater share of the existing budget. Russia and the US "have agreed to begin joint exploration of Mars and carry out joint unmanned interplanetary station flight programmes," Sergei Gorbunov, Rosaviakosmos spokesman said. "In addition, it was decided that Russia can take part in US space tenders," Mr Gorbunov added. Nasa is currently reliant on Russia to continue building the ISS and to ferry its crews back and forth after Nasa grounded its entire fleet following the loss of the space shuttle Columbia on 1 February. The ISS was put in jeopardy by the shuttle disaster. However, the Russian space agency is already hard-pressed financially and although it has been given a budget increase to cover the next six months it says it will be unable to meet its commitments next year without American help. Mr Gorbunov said the issue of additional US funding was not even broached at the meeting. Nonetheless Mr O'Keefe and Mr Koptev have given the green light to a programme to build a US-Russian space probe for the exploration of Mars. One senior Russian space agency official told Russian news agency Itar Tass that a similar joint project was started 10 years ago. Vasily Moroz from the Russian Space Research Centre said the two sides had considered using a US-built probe with a Russian booster rocket and descent module, but that the project was drawn to a halt by funding issues. The Moscow talks coincided with the deployment of a Soyuz craft which ferried a new crew to the ISS and brought back two Americans and a Russian in a dramatic re-entry that took their craft more than 400 kilometres (250 miles) beyond its intended landing site.

22235

SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT

May 14, 2003

MISSION: Mars Exploration Rover (MER-A vehicle/MER-2 rover)
LAUNCH VEHICLES: Delta II
LAUNCH PADS: 17-A
LAUNCH DATES: June 5
LAUNCH TIMES: 2:16 p.m. / 2:55:29 p.m. EDT

Mating of the MER-2 entry vehicle to the cruise stage was completed on May 7. The spacecraft has completed its weight and center of gravity determination and underwent its initial spin balance testing. On May 11 the spacecraft was fueled. Tomorrow night, May 15, will be second spin test now that the spacecraft is fueled. During routine testing of the cruise stage and the MER-2 rover over the weekend, an unexpected measurement in the rover's power system was observed. Troubleshooting is underway but it is not expected to delay the schedule of planned pre-launch spacecraft preparations at this time. The MER-A mission will have two launch opportunities each day during the launch period, which is scheduled to close on June 19. Arrival at Mars is set for Jan 4, 2004, regardless of the launch date within that period.On Cape Canaveral Air Force Station, the MER-A vehicle solid rocket booster erection begins today with the first three set of motors being attached to the first stage, the second set of three will be erected on Thursday, May 15, and the final set will be hoisted into position on Friday, May 16. The first stage was erected on Pad 17-A on Wednesday, April 23. The second stage erection was completed on Monday, April 28 and the fairing was hoisted into the white room on April 30. The Simulated Flight test of the first stage was successfully completed May 9. The spacecraft is scheduled to be mated to the third stage in the Payload Hazardous Servicing Facility (PHSF) on May 23. MER-2 will be transported to the launch pad on May 27.

80855

Uitstel lancering V.S. marsvoertuig

80856

Astrum: mei 2003.

De voor 30 mei geplande lancering met een Delta 2 raket van het eerste van de twee marsvoertuigen is met tenminste een week uitgesteld. Een probleem zou leiden tot een korte werking op de rode planeet. De lancering van het tweede toestel op 25 juni gaat nog steeds door.

SPACE.COM : 15 MEI 2003.

LAUNCH PREPARATIONS ON SCHEDULE FOR TWIN MARS SHOTS IN JUNE.

80857

CAPE CANAVERAL - The schedule remains tight but optimism continues to run high that NASA will launch a pair of probes toward Mars from Cape Canaveral Air Force Station in June. "If things keep going without any surprises that's still very achievable," Kennedy Space Center spokesman George Diller said Thursday. There's no padding left in the schedule to deal with any major last-minute problems and still make the targeted June 5 launch of the combined Mars Exploration Rover (MER)-A vehicle and MER-2 rover. The schedule is a little less hectic for the targeted June 25 launch of the combined MER-B vehicle and MER-1 rover. "They're both going to make the window, but the test team still has plenty of work to do," Diller said. The combined MER-A spacecraft is now fully fueled and is to undergo a final spin test on Friday. The test checks the spacecraft's weight, balance and center of gravity to make sure it will remain stable while spinning during its flight to the red planet.When that's complete the next major goal is expected on May 23 when the MER-A spacecraft is to be attached to the Delta 2 rocket's third stage, followed by the delivery of the spacecraft to the launch pad on May 27. At that point managers should have their best indication yet as to whether or not the mission will be ready to fly by June 5. A minor technical concern was discovered with the cruise stage during the past weekend. The trouble involved some wiring and fuses but the problem appears to have been easily solved. "It doesn't look like that's going to affect anything at the moment, so they're pressing on," Diller said. Meanwhile, at pad 17A the Boeing launch team continues to assemble the Delta 2 rocket for the first Mars-bound probe. Six of the nine solid rocket boosters have been attached to the first stage, with the final three to be installed on Friday. At neighboring pad 17B, the Delta 2 Heavy that will be used to send the second Martian probe on its way June 25 is being assembled. The rocket's first stage is already in place and its nine solid rocket boosters are to be installed next week. Liftoff of the first probe is expected on June 5 at either 2:16 or 2:55:29 p.m. EDT (1816 or 1655.29 GMT). The second sortie to Mars is set for blast off June 25 at either 12:38:16 or 1:19:19 a.m. EDT (0438.16 or 0519.19 GMT).

22236

FLORIDA TODAY - 19 MEI 2003

PUNISHING TESTS ENSURE MARS ROVERS READY. POTENTIAL PROBLEMS FOUND, FIXED BEFORE LAUNCHES.

CAPE CANAVERAL - In space, robotic probes soar silently, smoothly through the void. But getting to that point usually requires a sometimes frustrating, sometimes rewarding bout of punishing drop tests, trial runs and lessons on what can go wrong. During the past three years, a team of engineers has been busy designing and building a pair of identical Mars Exploration Rovers to roam over the Martian landscape. In the early phases of designing the rovers, engineers found a few bugs that, if they were not caught early enough, could have meant the end of the mission, especially during the critical atmospheric entry, descent and landing. Because of such unexpected challenges, the Mars Exploration Rovers so far cost about $100 million more than managers planned. Part of that extra money came at the expense of a future Mars mission. The Mars Smart Lander, scheduleù for a 2007 launch when it was first conceived, now is slated for 2009. The two Mars Exploration Rovers are scheduled to take off from Cape Canaveral Air Force Station on June 5 and 25. They will attempt to land on Mars in January 2004. When vehicles rove on a planet 90 million miles away, one hiccup can turn the mission into a disaster. The failure of two robotic explorers in 1999 proved that point. The Mars Climate Orbiter was lost when it entered the martian atmosphere lower than expected. The Mars Polar Lander's landing legs thought they had touched martian soil and the engine shut off early. The entry, descent and landing on Mars proved challenging for the new rovers, even in the early phases of the design process. Initially, mission planners tried to save money by adapting technology from the successful 1997 Pathfinder mission to Mars. Engineers found they couldn't take everything from the smaller Pathfinder and make it bigger to suit the needs of the larger Mars Exploration Rovers. "This was a fundamentally different project than Pathfinder was," said Dave Lavery, program executive for NASA's Solar System Exploration Program. "We didn't have quite as much commonality on the detailed level." The descent through Mars' atmosphere is nearly identical for the Pathfinder and Mars Exploration Rover missions. Delicate mission On Jan. 4, after a six-month journey, the first rover will start its entry through Mars' thin atmosphere. It will first encounter the atmosphere on the side of the planet opposite its chosen landing site: Gusev Crater. It will be flying at 14,000 miles per hour. During the trip through the atmosphere, an aeroshell capsule will contain the lander and rover. The thin Martian atmosphere slows the spacecraft down from 14,000 mph to 1,000 mph and a polyester-nylon parachute will be deployed six miles above the Martian surface. A set of solid rockets on the craft's underside will fire to assist the parachute in the thin atmosphere. And airbags that encase the lander will cushion the blow as it hits the surface and bounces to a resting place. The entire sequence will last 12 minutes. Upon landing, airbags will deflate and the rover must emerge from the cocoon-like shell of the lander. The rover and lander must go through 17 sequences -- from deploying exit ramps for the rover, to unfolding the solar arrays and popping the camera mast up -- just so the rover can get out and roam across the red soil. If either the parachute or airbag systems fail, the lander will drill into the Martian surface -- not exactly one of the missiøn's stated goals. The mission would end before it began. The twin rovers turned out to be heavier than planners anticipated. Pathfinder was about 23 pounds upon landing. Each of the twin rovers weighs about 375 pounds on Earth. During the design, the weight of the rover system grew by about 40 percent. That meant the systems designed to protect the rovers during descent had to be able to withstand the added weight. The new parachute is about 40 percent larger than the Pathfinder parachute. To try to make the parachute lighter to save weight, engineers tried a new lightweight material. But the parachute wasn't strong enough to support the heavier spacecraft and ripped when it opened. So engineers switched back to the old material. When the spacecraft descends to slightly more than a half-mile in altitude, a set of four airbags, each with six lobes, will simultaneously open around the spacecraft, like a kernel of popcorn popping. The airbags will cushion the blow of the lander as it hits the Martian surface. Like Pathfinder, the lander will bounceacross the surface to a stop. The new rovers could bounce as far as 0.6 miles in the course of about 10 minutes. Even with Mars' lower gravitational pull, it is important the airbags work properly. At the beginning of 2001, workers took spare airbags from Pathfinder and conducted drop tests. Instead of dropping airbags randomly onto a rock field, they systematically dropped the airbags onto different sizes and shapes of rocks to see whether they could break them. "Sure enough, we could," said Richard Cook, the rovers' flight systems manager. Their solution was to redesign the airbag. The new airbags have two airtight layers covered with protective cloth instead of the single bladder used on Pathfinder. That way, if a sharp rock or boulder punctures the outer layer, the inner layer will protect the rover. Communications. The rovers recently experienced another bout of technical troubles. During testing at Kennedy Space Center, workers uncovered a potential problem that could have affected communications during a crucial part of the mission. Cables connecting the spacecraft to the rover are cut during the fall through the atmosphere by seven little guillotine-like cable cutters. Those connecting the rover to the lander are cut after landing. "We need to be able to communicate with the lander and internal rover electronics once the cruise stage separates," Cook said. "It turns out the electronics did not allow this (to) occur as planned, so we had to change the hardware." The concern is one of the hundreds of wires in the cable could short when it's cut. If that happened, the electronic parts would not be able to communicate with one another. "It is very unlikely that this will occur in flight, but we can't absolutely rule it out," Cook said. "To be as conservative as possible, we decided to do the test and uncovered the problem." This discovery prompted mission managers to delay the first launch by a week to work ontelecommunication-support boards in both rovers. The boards were reinstalled in the rovers April 16 and 18. NASA officials are trying to figure out why the problem didn't show up on an earlier test. Lavery said the team's biggest challenge was getting the project together in 37 months. Using Pathfinder technology saved time, but "even with that, it's a very tight schedule," Lavery said. The rovers must launch in 2003. Mars and Earth are on the same side of the sun and at the shortest distance from each other. However, they're still 90 million miles apart, the same distance from Earth to the sun. "This particular launch opportunity is the best opportunity for Earth and Mars for 20 years," Lavery said.

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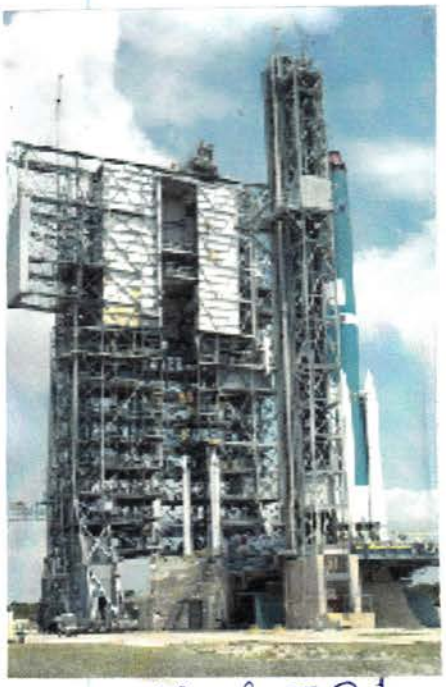

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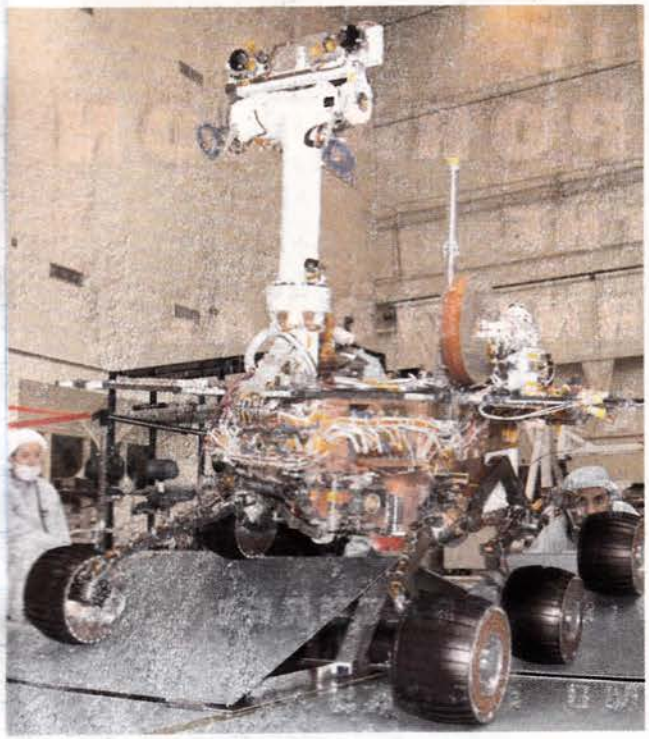


Mars Exploration Rover undergoes mobility tests at the Jet Propulsion Laboratory. Cameras on top of mast are about 4.3 ft. above the ground.

Rover pair will search for signs of ancient water along the dry equator

MICHAEL A. DORNHEIM/PASADENA, CALIF.

Early next year, Mars should be under direct observation by six spacecraft, a situation not seen since 1978 when two Viking orbiters and two Viking landers were active at the planet.

The two Mars Exploration Rovers (MERs) set for launch next month are the most complex spacecraft to come out of the Jet Propulsion Laboratory (JPL) since Cassini launched to Saturn in 1997. They are like slow-moving field geologists looking for evidence of past water and ancient life. Each is capable of up to 1 km. (0.6 mi.) of travel during their 90-Mars-day (90 "Sols," 92 Earth days) mission.

And on June 2, the European Mars Express mission is to launch on a Soyuz rocket carrying both the Mars Express orbiter and the Beagle 2 lander, which has a sampling arm and chemistry analyzer.

On Jan. 4 and Jan. 25 the MERs will join the Mars Global Surveyor and Mars Odyssey orbiters overhead, which provide observations from a different viewpoint and also serve as communications relay satellites for the rovers back to Earth. "We are ready to obtain ground truth on the orbiter observations," said Orlando Figueroa, director of the Mars Exploration Program at NASA headquarters. For example, the infrared spectrometer on the rovers is similar to one on Mars Global Surveyor, which has 3-km. resolution.

The rovers are more than an order of magnitude heavier than the Sojourner rover of the 1996 Mars Pathfinder mission. That weighed 10.5 kg. (23 lb.) while the new ones tip the scales at 185 kg. They carry five main science instruments and a rock grinder, including four on a turret on the robotic arm (*AW&ST* Dec. 11, 2000, p. 68). They are:

- The rock abrasion tool (RAT) on the turret, the equivalent of a geologist's rock hammer to chip away the weathered outer layer and access the original material within. Pathfinder did not have such a tool. "We were frustrated on Pathfinder because many surfaces have dust on them, and have weathered rinds," said Joy Crisp, the JPL project scientist. The device grinds a 4.5-cm. (1.8-in.) circle 5-mm. (0.2-in.) deep.
- Microscopic imager (MI) on the turret, the equivalent of a geologist's hand lens. It has 30-microns-per-pixel resolution and views a 31 X 31-mm. patch of rock with a monochrome 0.4-0.68-micron visual-band sensor using light from the Martian sky. Arm motion as small as 2 mm. is possible to take stereo shots.
- The alpha particle X-ray spectrometer (APXS) on the turret. Six radioactive curium-244 sources emit both alpha particles and X-rays, and sensors measure the energy spectra of the backscattered radiation. "The device is like the APXS on Pathfinder but has better detectors and removes the atmosphere's carbon dioxide signal that was a problem on Pathfinder," Crisp said. A better signal-to-noise ratio allows detection of rare minerals down to 0.5-1% by weight. The proton mode used on Pathfinder has been eliminated because improvements in the X-ray sensor make it unnecessary.
- Mossbauer spectrometer (MB) on the turret. This is aimed at iron-bearing materials in the soil and can distinguish different oxidation states, which are related to temperature and water conditions when they were formed, giving clues to whether conditions were conducive to life in Mars' early history.
- Panoramic stereo camera (Pancam). It has about three times better resolu-

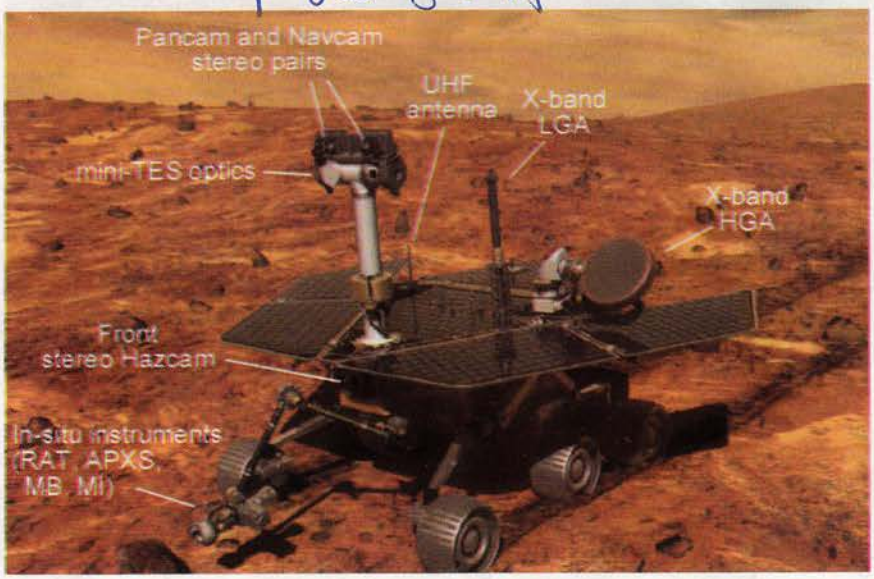
Red Rover

tion than the Pathfinder camera and is equivalent to 20/20 vision, Crisp said. The two sensors are on top of the Pancam mast assembly (PMA), which is about 1.3 meters above the planet surface. A full turn of the mast gives a 24,000 X 4,000-pixel mosaic. Each camera has an eight-position filter wheel and is sensitive in the visual to near-infrared region of 0.4-1.1 micron wavelength.

● Mini-thermal emission spectrometer (Mini-TES). It is the first infrared spectrometer on the surface of Mars, and is used to remotely measure types and abundances of minerals, and also can look at the sky for temperature, water vapor and dust abundance. Mini-TES covers a wavelength of 5-29 microns with a selectable spatial resolution of 8 or 20 milliradians. The detector is in the body of the rover and uses the camera mast as a periscope, viewing in the opposite direction of the Pancam axis. A mirror in the mast head scans -50 to +30 deg. in elevation.

The MB, APXS and Mini-TES cover for each other's deficiencies to provide a synergistic view of a rock sample, Crisp said. "There'll be real excitement if we find iron-bearing carbonates or clays; that would point to water." Another experiment is a set of magnets at different spots on the rover deck and RAT to attract magnetic dust where it can be viewed by the arm sensors and Pancam.

The site for the Jan. 4 landing is Gusev Crater, which has what appears to be a dry riverbed going into it from the south. "There had to have been a lake in Gusev Crater at some point," said Steven Squyres, principal investigator for the science instruments. Gusev is located 15 deg. south of the equator. The Jan. 25 landing is set for Meridiani Planum, which appears to have the mineral gray hematite, according to TES observations from Mars Global Surveyor. Gray hematite is usually formed in the presence of liquid water. Meridiani Planum is about 2 deg. south latitude and on the opposite side of Mars from Gusev, which means that both rovers won't be pointing at the Earth at the same time and competing for communications resources.



Rover carries five main science instruments. X-band low-gain antenna (LGA) and high-gain antenna (HGA) give direct-to-Earth communications.

MER cost is $804 million, including the two launchers and operations for each rover's 90-Sol prime mission. The Delta II launchers are about $60 million each. Earlier, the mission was to be $688 million but cost grew primarily to make the tight schedule (see story on p. 56).

The first launch is set for June 5, which slipped from May 30 because of a last-minute cabling problem fixed at Kennedy Space Center. The Delta II 7925 rocket provides enough energy to carry the launch window through June 16. The second launch is on a Delta II 7925 Heavy, which has 40% more impulse in its strap-on boosters, allowing a June 25-July 12 launch window. The close launch windows put pressure on Kennedy operations (see story on p. 58).

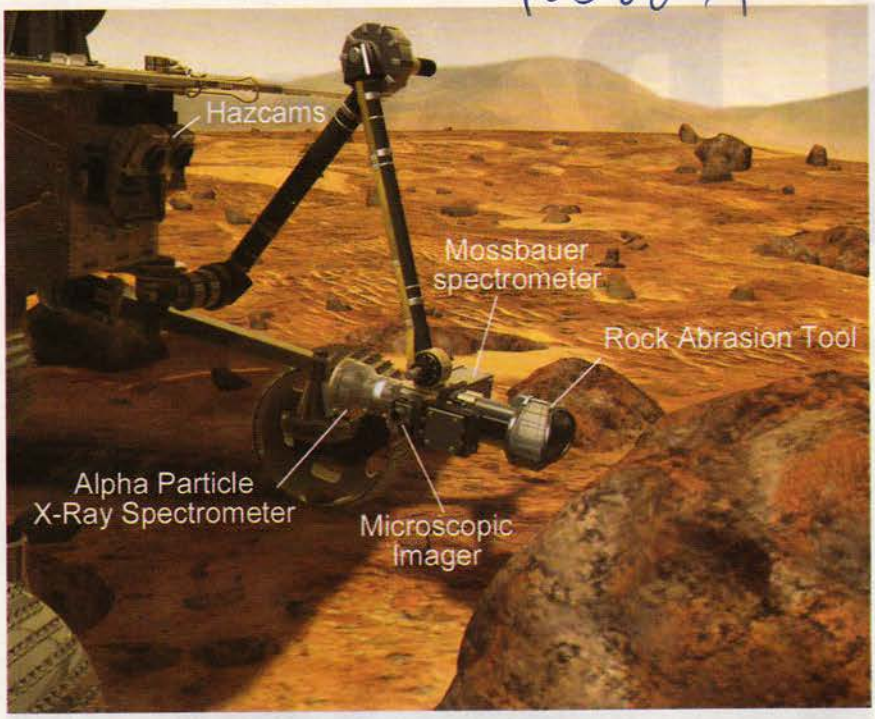
A Thiokol Star 48 solid rocket upper stage fires for 90 sec. to put the spacecraft on its trajectory to Mars, and then it is a coast for the next seven months, with six planned trajectory correction maneuvers along the way.

The cruise stage is a disk-shaped 8.7-ft.-dia. structure attached to the upper end of the aeroshell containing the lander and rover. The design is inherited from Mars Pathfinder. It has its own solar cells, thrusters and monopropellant hydrazine fuel tanks. There are two thruster clusters, each with four 1-lbf. rockets firing axially and laterally for course adjustment and to change attitude of the spacecraft, which is spinning at 2 rpm. The cruise assembly weighs 2,343 lb. fully fueled.

The rover's computer is active and is the central brain controlling the cruise stage. Similarly, the rover's X-band communications hardware is active, operating through cables to low-gain and medium-gain antennas mounted on the cruise stage.

The enclosed rover is generating heat, leading to a Freon cooling system to get rid of the heat. A Freon pump on the cruise stage feeds pipes through the aeroshell and lander to cool the rover, and can reject 150 watts of heat through a circumferential set of 10 radiators. Pathfinder had a similar system.

The spacecraft turns to entry attitude 70 min. before hitting Mars' atmosphere and starts venting the Freon. At 15 min. before entry, pyrotechnic cutters sever



Rock abrasion tool grinds off surface so three instruments on arm turret can analyze unweathered rock. Stereo hazard cameras navigate rover and arm to rock.

the cooling, antenna and electrical connections to the cruise stage, separation nuts fire and springs push the 1,808-lb. aeroshell away. It hits the atmosphere at 12,000 mph. on a 12-deg. descent angle. After peak deceleration of 6.2g, a 15-meter parachute opens, followed by jettisoning of the lower heat shield.

The lander descends like a spider on a 20-meter bridle from the backshell and parachute. Radar picks up the ground, and at 8 sec. before impact, airbags on each of the lander's four sides start to inflate. At 6 sec. and 115 meters above the ground, three retrorockets in the backshell start to fire, sized to bring the descent rate to zero at 15 meters above the ground. To reduce lateral drift, a second set of rockets may fire to alter backshell attitude before the retrorockets fire, depending upon inertially-measured attitude and wind drift estimated by a descent imager. Just as in cruise, it is the hidden rover that is controlling all this activity. Its computer is not redundant.

The inertial system detects when the descent rate is zero and chops the bridle to the backshell, dropping the airbag-covered lander onto the surface at 10-20 meters/sec. (33-66 fps.). Bouncing and rolling should stop within 5 min., the airbags start retraction at 66 min., and at 96 min. after landing, the lander petals begin to open. The lander is a tetrahedron enclosing the rover, with the lander on the base surface and three petals folded up against it.

During entry and descent there is continuous telemetry to Earth via direct X-band link transmitting different tones reflecting orbiter state, and while on the bridle via UHF relay to Mars Global Surveyor at 8 Kbps. This is a direct fallout of the loss of Mars Polar Lander in 1999, which deliberately shut off communications before entry and was never heard from again, leaving investigators to probabilistic speculation.

While the airbags look similar to those on Mars Pathfinder, the MER lander plus rover at 1,175 lb. is about 50% heavier, and the old system would not do. Extra layers of Vectran fabric were added and allowable impact velocity was reduced to 25-26 meters/sec. from 30 meters/sec. Rover weight grew at least 20% during development, and engineers believe MER is at the upper edge of what an airbag will do.

The scheme for exploration is to examine a site with the Pancam and Mini-TES, select the best examples of rocks, then travel to them and measure their constituents. Each rover is to visit at least four sites and travel more than 600 meters, which will triple the Martian locations examined by humanity.

Power and thermal considerations constrain daily activities and force the rover computer to shut down at night and during periods of the day. After 90 Sols, engineers estimate solar power will drop 25% due to dust buildup on the arrays, and seasonal shift from summer to fall will further reduce power and temperature. Failures are expected from components getting too cold at night. The Viking 1 lander, powered by radioisotope thermoelectric generators, lasted more than six years, but JPL project manager Peter Theisinger has bet a Coke that MER will last less than 130 days.

Can $$$ Buy Time?

Complex rovers were developed in a dangerously short period

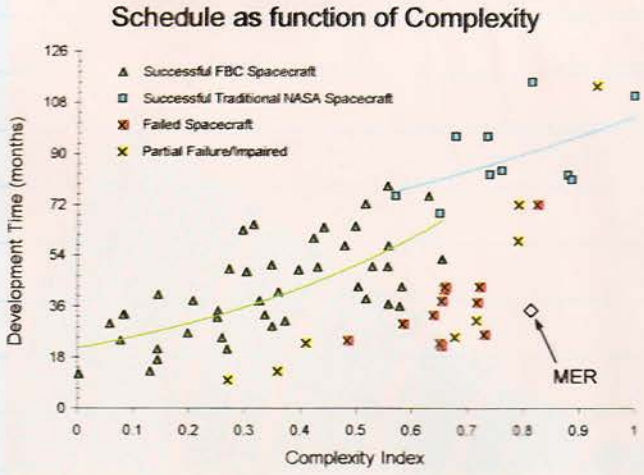
MICHAEL A. DORNHEIM/PASADENA, CALIF.

The Mars Exploration Rovers are complex spacecraft developed under a tight schedule, a classic recipe for disaster. NASA is fully aware of this, and unlike the agency's prior "Faster, Better, Cheaper" philosophy, is now willing to throw money at the problem. Today's tune might be called "Faster, Better" but not "Cheaper."

Can extra resources make up for limited time? The answer will be revealed as the mission unfolds, but since the project is a single data point, there won't be much statistical confidence in the result.

The shortage of time is apparent in a comparison made by The Aerospace Corp. This technique was reported by *Aviation Week & Space Technology* in 2000 and has been updated to include Mars Exploration Rovers (MERs) and other programs (*AW&ST* June 12, 2000, p. 47). The method assigns MER a Complexity Index of 0.81, on a scale where 1.0 is the most complex spacecraft in the database and 0 is the least complex. That puts it at the same level as Cassini and Galileo, both major Jet Propulsion Laboratory (JPL) programs that had much longer development times (see top graph on p. 58).

MER had only 34 months from pro-



gram go-ahead in July 2000 to the opening of the launch window on May 30, 2003. The average successful traditional mission of this complexity took 90 months to develop, and the shortest one in this area took 80 months. That means that MER's development time is 3.8-4.5 years shorter than the historical norm, or only 38-43% of that time. The MER point on the chart sits in a sea of red dots of failure.

"At the get-go we knew the schedule was very tight," said Orlando Figueroa, director of the Mars Exploration Program at NASA headquarters. Thirty-four months from start to launch "is almost unprecedented for a mission like this."

MER found itself in this position because of a fixed, unusually favorable launch opportunity in 2003, and a late start from the fallout of the dual Mars Polar Lander and Mars Climate Orbiter failures in 1999. That resulted in the 2001 lander mission being canceled and a period of uncertainty on how to proceed with 2003.

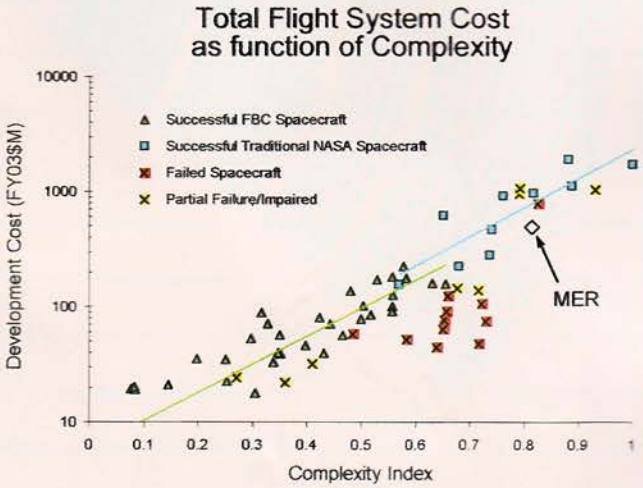
The schedule risk may be lower than it appears because the methodology doesn't take account of double shifts, extra testbeds and other tactics employed by MER management, said David A. Bearden, Aerospace Corp. director of NASA/JPL Advanced Programs who devised the Complexity Index methodology.

The good news is that the MER budget is above the red dots and in the region of success (see lower chart). NASA has moved away from constrained budgets to ones fully funded at the level of traditional missions, Bearden said. The development cost on this chart does not include the launch and is for the first article—it excludes the second rover—and was estimated at $480 million by Bearden. The comparable figure should probably be higher because much of the science payload may have already been paid for by the canceled 2001 lander.

What has been done? "We opened resources, and there was a tradeoff in requirements," Figueroa said. "We defined the performance floor where there still could be a good science mission." Tactics to mitigate the tight schedule include:

- "We have the best group of people, both in technology and program management," Figueroa said.
- Having extra hardware and four main testbeds for parallel development with different teams running them. "It's a challenge to coordinate them, but JPL has done quite well," he said. Having two rovers increased testing flexibility.
- Running double shifts when appropriate for parallel activities.
- MER being an in-house, high-visibility project that will reflect strongly on JPL, the laboratory has given the team access to all resources, "almost on demand." This raises a question about the real cost if there is a large amount of JPL's overhead and discretionary budget directed to MER.

Knowing there would be pressure to cut corners if the schedule proved too tight, the project and JPL top management signed onto a list of tests that must be passed before launch approval is granted. Changes must be OK'd by laboratory management. So far the list is "99.9% intact," Figueroa said. The shock test of an internal component was waived when it was shown to add risk and be unrealistic.



"MER is very fast, but we think NASA funded it adequately," Bearden said. "'Can you buy time?' is the question that's being addressed."

Batteries Included

Complex dual Mars rover assembly challenges JPL/Kennedy teams

CRAIG COVAULT/KENNEDY SPACE CENTER

Final processing of the two Mars Exploration Rovers set for launch on Delta II boosters June 5 and June 25 has involved the most intensive twin lander spacecraft assembly and checkout flow at the launch site here in more than 25 years.

The twin spacecraft effort, tied to a short Mars launch window, harkens back to a time when the U.S. space program routinely sent dual identical missions to the planets—a strategy once abandoned now revived for the Mars Exploration Rover (MER) Program.

Prior to the MER effort, the most recent dual lander campaign involved the Viking Mars missions launched in 1975 on Titan III/Centaur boosters.

The Jet Propulsion Laboratory (JPL) organized the processing flows here under two largely autonomous teams, said Richard Brace, MER deputy project manager. The checkout and assembly of each MER mission vehicle involved

JPL technicians at Kennedy use rig to precisely lower the first Mars Exploration Rover onto its landing base petal. Folded arrays are gold. Cruise stage is at left.

the integration of the wheel-equipped mobility systems, electronics modules, solar array-covered rover equipment decks, installation of the instrument deployment device on the front of each vehicle and their camera masts as well as tests of the overall systems and Athena science instruments on each vehicle.

Each rover was then integrated with its lander base petal, part of the tetrahedron in which it is encased. Three side petals were then added to the base petal, and landing air bags and their retraction systems were integrated with the petals.

All of that was put in the lander back shell which was integrated with its parachute and retrorockets. The heat shield and circular cruise stage was then added and the entire assembly mounted on respective Delta II third stages.

Unlike Viking where the two Mars landers were processed in different facilities, both rovers were processed in Kennedy's Payload Hazardous Servicing facility with a large 100,000-Class clean room.

This has resulted in the unique scene here where about 25 engineers and technicians assigned to MER-1 have hovered over their spacecraft at one end of the room while a similar MER-2 team has worked on their rover at the other end of the same facility.

The scene has had the surrealistic looks of a "Martian chop shop" akin to an unworldly car assembly and teardown operation with rover wheels and chassis, the Mars entry vehicles and the cruise stages all tended by two large teams clad in white clean-room bunny suits with face masks.

There was a phased delivery process of the major MER flight elements to Kennedy coordinated with the test of major elements at JPL.

THERE ARE several major elements to each mission—the rover and its lander, its Apollo-shaped entry vehicle and the large circular cruise stage.

In mid-January, the cruise stage and entry vehicle for one rover was shipped to Kennedy to begin early processing, while the first rover arrived here in mid-February along with the second cruise stage and entry system. Then in March, the second rover was shipped.

The original plan was for the two teams to bring both rovers to flight status simultaneously, then about six weeks before launch, choose which spacecraft would be designated for the first launch now set for June 5. As it turned out, the hardware for MER-2 pulled ahead of MER-1, so from a hardware designation standpoint, the MER-2 rover will be the first to launch and land.

The overall sequence started more than a year ago at JPL when Rover-1 was assembled and integrated with both its entry and cruise systems for launch dynamics and thermal vacuum tests. The rover was then removed from the entry system and run through Mars landing loads and Mars thermal tests.

Meanwhile, Rover-2 was assembled on its base petal for a series of tests in that configuration. Since Rover-2 did not undergo the same overall JPL assembly and disassembly, its JPL sequence put it somewhat ahead of Rover-1 for the initial launch slot here.

About 100 JPL engineers and technicians have deployed to Kennedy for the two processing flows. In addition to individual system responsibilities, the two groups have also had their own quality assurance staffs. At times, the total JPL team here has pushed toward 150 as "itinerant" technical staff has been brought in for specialized test and assembly.

Separate sets of mechanical and electrical test hardware were also brought to Kennedy so each lander could be put through facility-related tests independent of the other.

Although the individual rover teams are separate, the processing has been coordinated overall by a plant flow man-

Side petals with landing air bags are attached during final Kennedy processing. Airbags will inflate like popcorn to cushion Martian landing. Bags are thicker than Pathfinder's.

ager and individual mechanical system and electrical system lead managers, Brace said.

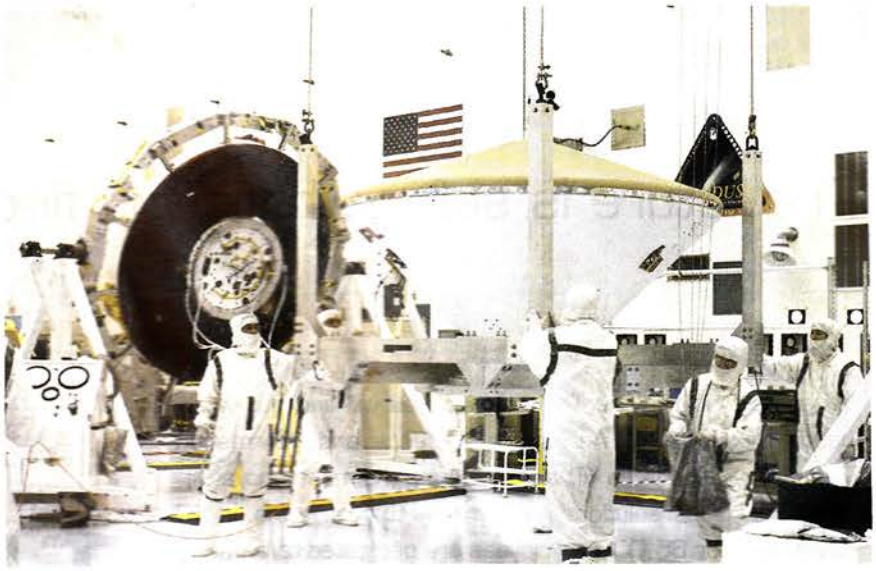
The various team leads chaired meetings twice daily at 7 a.m. and 1 p.m. local time to coordinate work and to coordinate when necessary with JPL. Meeting the launch schedule has been the overriding challenge requiring a "tactical strategy" of when to cycle in extra tests and help from Pasadena.

Mechanically, the two rovers are the most complex unmanned spacecraft ever built and checked out at JPL and at Kennedy. "The complexity of these things is extraordinary," Brace said. Each rover underwent several "critical deployment" tests where the wheel bogies, the instrument deployment device, camera boom and solar arrays demonstrated they would unfold properly.

The teams also worked several problems including a cabling issue that delayed the first launch a week to June 5, reducing its available window by about 30%. When the rovers arrived, the first mission had about 10 days of schedule margin. It needed every bit of that plus a week more.

Although substantial weekend work was required to keep the assembly and tests on schedule, the MER team was mindful of findings by past Mars mission failure reviews that called for more vigilance on technician rest needs.

Other improvements from those reviews led to the collocation of project office, system engineering and flight software managers to foster cross-element communications and more frequent meetings with the hardware vendors. That cross coordination is especially critical for the rover design where there is a lot of cross coupling between individual systems in the vehicles.



Martian atmospheric entry shell with brown heat shield on bottom and first rover inside is prepared for integration at Kennedy with its large circular cruise stage at left.

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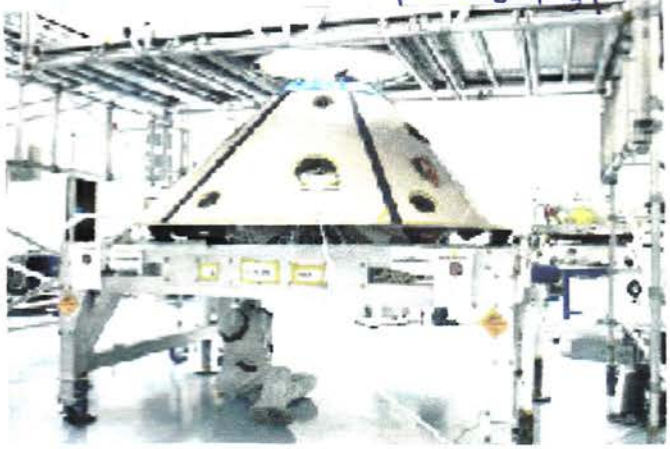

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KSC PRESSRELEASE : 23 MEI 2003.

MARS EXPLORATION ROVER SPACECRAFT UNDERGO BIOLOGICAL TES/TING AND CLEANING PRIOR TO JUNE LAUNCHES

What do NASA's soon-to-be-launched Mars Exploration Rover (MER-1 and MER-2) spacecraft have in common with the Viking and Voyager spacecraft launched decades ago? Besides being interplanetary explorers, they will be among the biologically cleanest spacecraft ever launched from Cape Canaveral Air Force Station. Making sure the spacecraft are as biologically clean and contamination-free as possible before they leave Earth is NASA's planetary protection (PP) policy. It protects other solar system bodies from Earth life and protects Earth from extraterrestrial life that may be brought back by returning space missions. NASA's policy is based on the most recent understanding of planetary conditions and biology, and regular recommendations from the US National Academy of Science. "Keeping the spacecraft as clean as possible before, during and after launch is very important for any science instruments searching for organic compounds on the surface of other planets," said Laura Newlin, Jet Propulsion Laboratory (JPL) engineer and Planetary Protection (PP) Lead for the MER missions. JPL's Biotechnology and Planetary Protection Group seeks to advance spacecraft cleanliness, sterilization and validation technologies for NASA's solar system exploration missions. "Up to 300,000 spores are allowed on the exposed surfaces of the landed spacecraft," said Newlin. "That many spores would fit on the head of a large pin." A companion requirement to this is the average spore density on the surfaces must be less than 300 spores per square meter (28 spores per square foot). There are approximately 4500 square meters (approximately 48,000 square feet) of surface on each MER spacecraft, including the cruise stage. When the spacecraft arrived at KSC from JPL in February and March, they were transported to the Payload Hazardous Servicing Facility in KSC's Industrial Area. Prior to that, the highbay and ground support equipment were cleaned, sampled and recleaned to reduce further biological contamination when the spacecraft arrived. Both spacecraft have since undergone extensive alcohol-wipe cleaning and bio-testing processes. They were disassembled and cleaned to remove any contamination that may have occurred during the cross-country transport. During reassembly, JPL PP team members sampled surfaces of both spacecraft to check for microbial spores. Culturing of the samples was performed in several KSC life sciences labs using equipment from JPL or provided by KSC including media claves, sonicators, water baths, incubators, microscopes, bio-safety hoods, and a large magnified colony counter. "Currently our total spore count on the surface of both MER vehicles is comfortably under 200,000. So we are below the allowable level," Newlin said. Other PP strategies exist for MER surfaces that are inappropriate for the traditional cleaning method. These include dry heat microbial reduction of the hardware in a dry environment at 125 degrees Celsius (257 F.) for five hours. The process is performed piece by piece on large surface areas that can tolerate the temperature, such as thermal blankets, airbags, honeycomb structures and parachutes in their cans.A High Efficiency Particulate Arrestor (HEPA) filter is also used to filter out 99.97 percent of particles that are 0.3 microns or larger on MER's electronic boxes and the rover body. These permanent fixtures will also help filter out the Martian dust when the MER spacecraft land on Mars. Spacecraft propellant lines were also precision cleaned.According to Newlin, the PP team worked with the spacecraft design engineers to determine PP strategies, what hardware should be cleaned and what hardware would require other PP approaches, all of which were integrated into the design, fabrication, and assembly of the spacecraft.

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT May 27, 2003

MISSION: Mars Exploration Rover (MER-A)
LAUNCH VEHICLES: Delta II
LAUNCH PADS: 17-A
LAUNCH DATES: NET June 8
LAUNCH TIMES: 2:05:55 p.m. / 2:44:07 p.m. EDT

The MER-2 rover, mated to the upper stage booster and contained within its payload transporter rolled out of the Payload Hazardous Servicing Facility this morning at 2:20 a.m. It arrived at Pad 17-A at 4:30 a.m. It was hoisted atop the Boeing Delta II rocket at 9:15 a.m. A spacecraft state of health check is scheduled to occur on Wednesday and the integrated vehicle/spacecraft Flight Program Verification test will follow on Thursday. Installation of the fairing around the spacecraft is scheduled to occur this Saturday, May 31. Fueling of the Delta second stage with its complement of storable hypergolic propellants is currently planned to occur June 5. Some additional schedule margin is being added to complete the management reviews required prior to launch. Therefore, launch is being retargeted to occur no earlier than June 8. A final decision on the launch date will be made next Monday, June 2. MER-A will have two launch opportunities each day during the launch period that closes on June 19. Arrival at Mars is set for Jan 4, 2004, regardless of the launch date within that period. The Delta first stage for MER-A was erected on Pad 17-A on April 23. The second stage erection was completed on April 28, and the fairing was installed in the white room on April 30. The solid rocket booster erection began on May 13 with the first set of three motors being attached to the first stage. The second set of three was erected on May 14, and the final set was hoisted into position on May 15. The Simulated Flight Test, an electrical test of the vehicle's systems used during powered flight, was successfully completed on May 21.

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KSC PRESSRELEASE : 27 MEI 2003.

MER-A MARS EXPLORATION ROVER TARGETED FOR LAUNCH JUNE 8

The first of two Mars Exploration Rovers, MER-A, is targeted for launch no earlier than Sunday, June 8 at 2:05:55 p.m. EDT. Liftoff will occur aboard a Boeing Delta II launch vehicle from Pad A at Space Launch Complex 17 on Cape Canaveral Air Force Station. A second launch opportunity exists at 2:44:07 p.m. EDT, if necessary. Should launch be delayed by 24 hours, the two launch times available are 2:02:23 p.m. and 2:40:30 p.m. EDT. The planetary launch period window extends through June 19. The second of the two rovers, MER-B, is scheduled to launch June 25. MER-A will reach Mars on Jan. 4, 2004, and MER-B on Jan. 25. The two MER missions seek to determine the history of climate and water at two sites on Mars where conditions may once have been favorable to life. Both rovers are identical. Each rover carries five scientific instruments including a panoramic camera and microscope, plus a rock abrasion tool that will grind away the outer surfaces of rocks to expose their interiors for examination. The rovers each weigh approximately 400 pounds. They will navigate themselves around obstacles as they drive across the Martian surface, traveling up to about 130 feet each Martian day. Each rover's prime mission is planned to last three months on Mars.

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SPACE.COM : 27 MEI 2003.

NASA DELAYS FIRST ROVER LAUNCH AT LEAST THREE DAYS.

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CAPE CANAVERAL - NASA's first of two missions destined for launch to Mars in June was delayed at least three days so more time could be spent on engineering reviews, officials said Tuesday. Mars Exploration Rover-A (MER-A) -- a two-part spacecraft that includes a lander amd rover -- is now targeted to fly no earlier than June 8, said Kennedy Space Center spokesman Bruce Buckingham. A June 8 liftoff would be targeted for precisely at 2:05:55 p.m. EDT (1805.55 GMT). A second launch opportunity exists at 2:44:07 p.m. EDT (1844.07 GMT). Even as engineers and managers give their paperwork a final look, the spacecraft was hauled out to its launch pad at Cape Canaveral Air Force Station and attached to the top of a Delta 2 rocket Tuesday morning. The launch processing at complex 17 is continuing on schedule and mission managers hope to set a new official launch date on June 2 -- the same day the European Space Agency's Mars Express probe is to launch from the Baikonur Cosmodrome in Kazakhstan. NASA has until June 19 to launch MER-A to the Red Planet. The MER-B spacecraft remains set to launch on June 25. If all goes well during launch and months of cruise toward Mars, MER-A is set for landing on Jan. 4, 2004, with MER-B following on Jan. 25. As now planned, the first rover is targeted to land at Gusev Crater, 15 degrees south of Mars' equator. The second is to touch down at Meridiani Planum about two degrees south of the equator and halfway around the planet from Gusev. The two MER missions will seek to determine the history of climate and water at two sites on Mars where conditions may once have been favorable to life. Both rovers are identical and carries five scientific instruments including a panoramic camera and microscope, plus a rock abrasion tool that will grind away the outer surfaces of rocks to expose their interiors for examination. The rovers each weigh approximately 400 pounds. They will navigate themselves around obstacles as they drive across the Martian surface, traveling up to about 130 feet each Martian day. Each rover's prime mission is planned to last three months on Mars.

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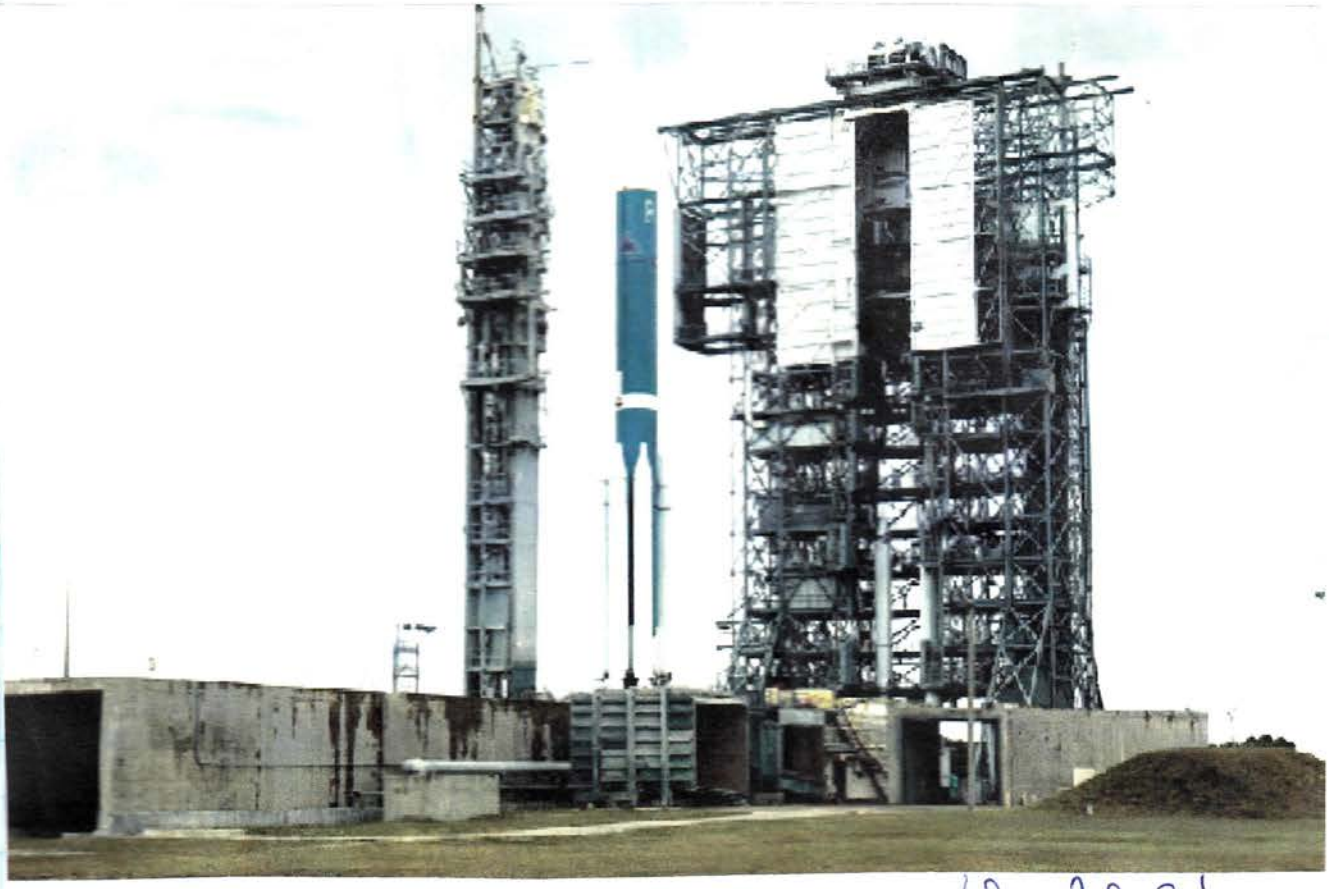

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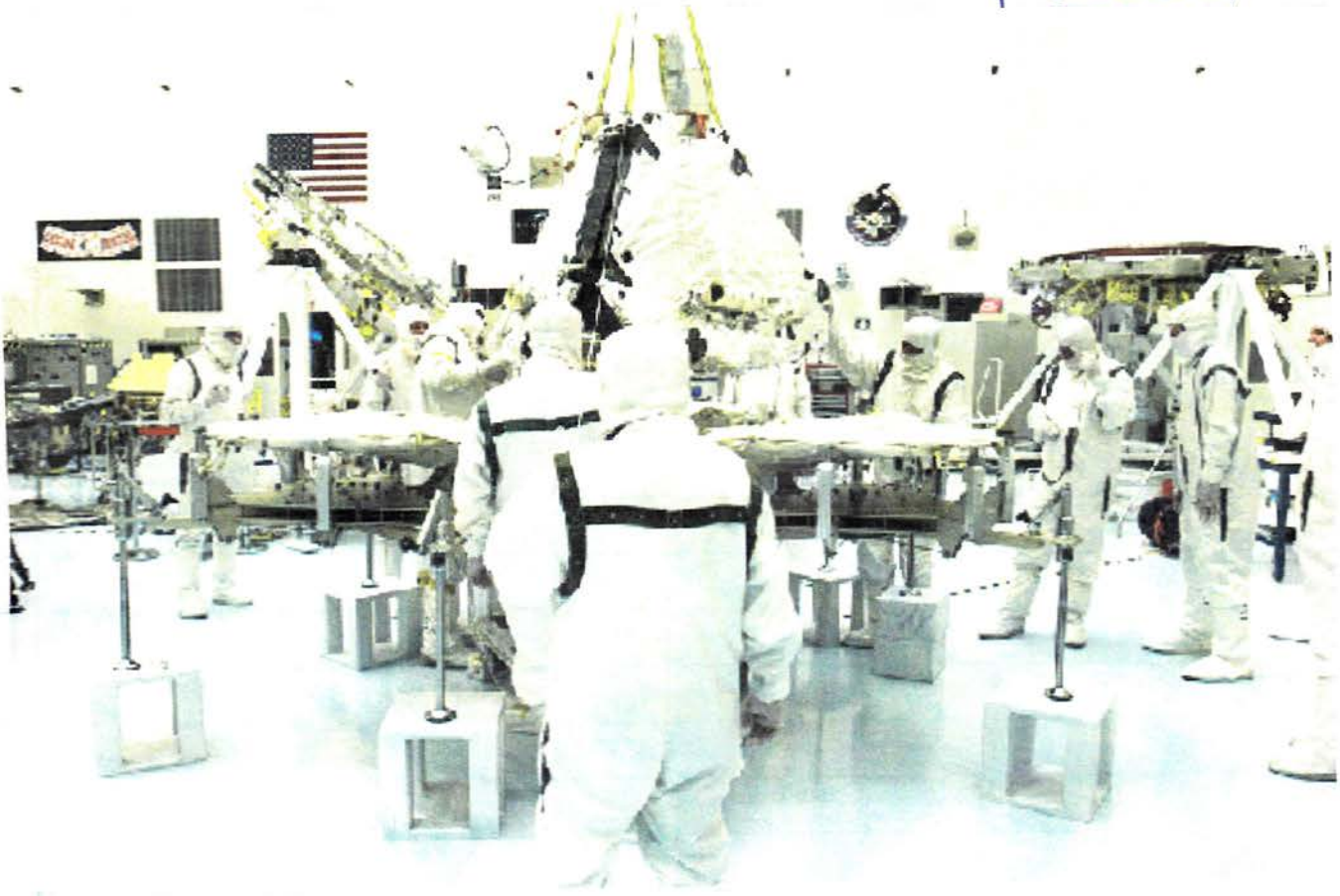

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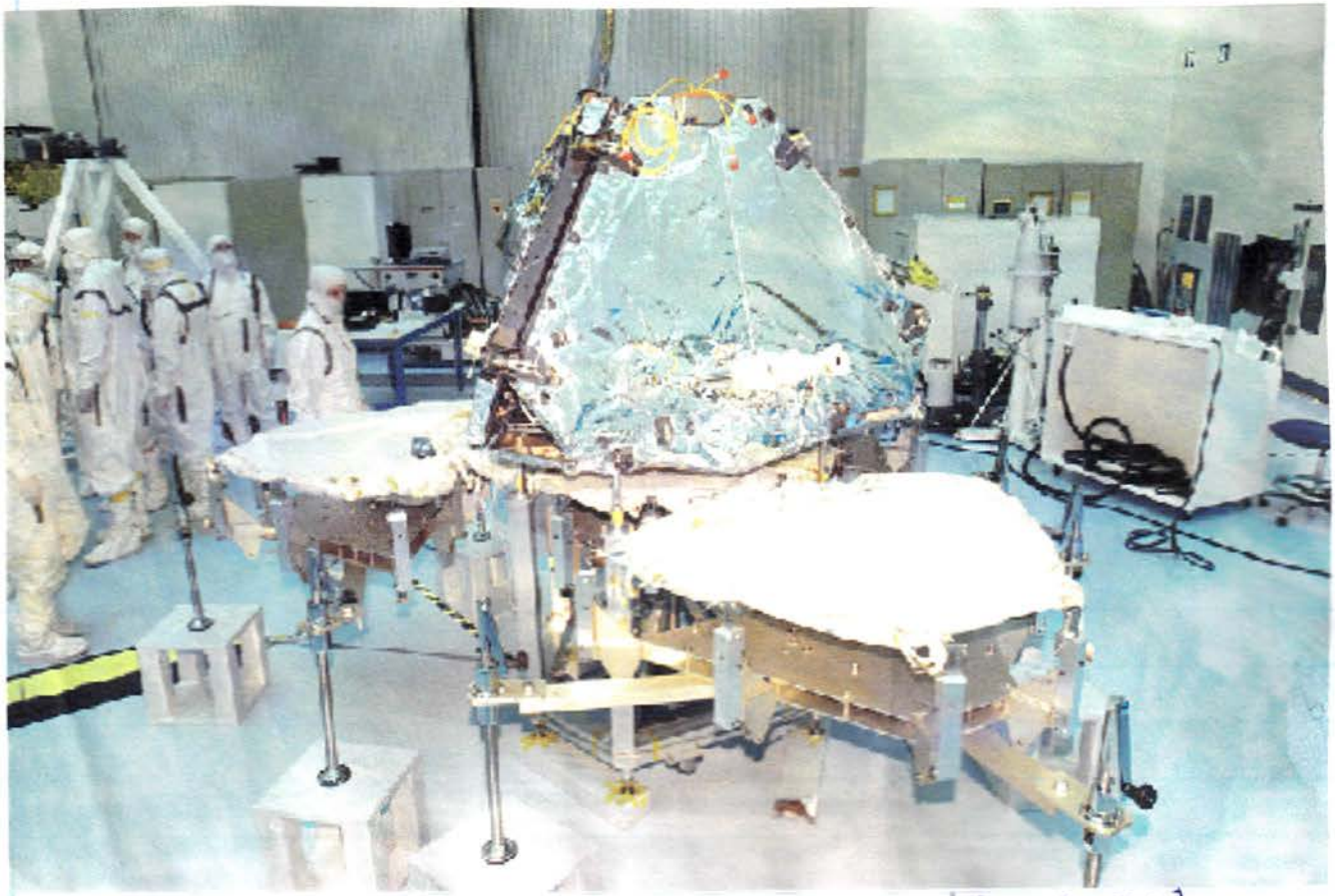

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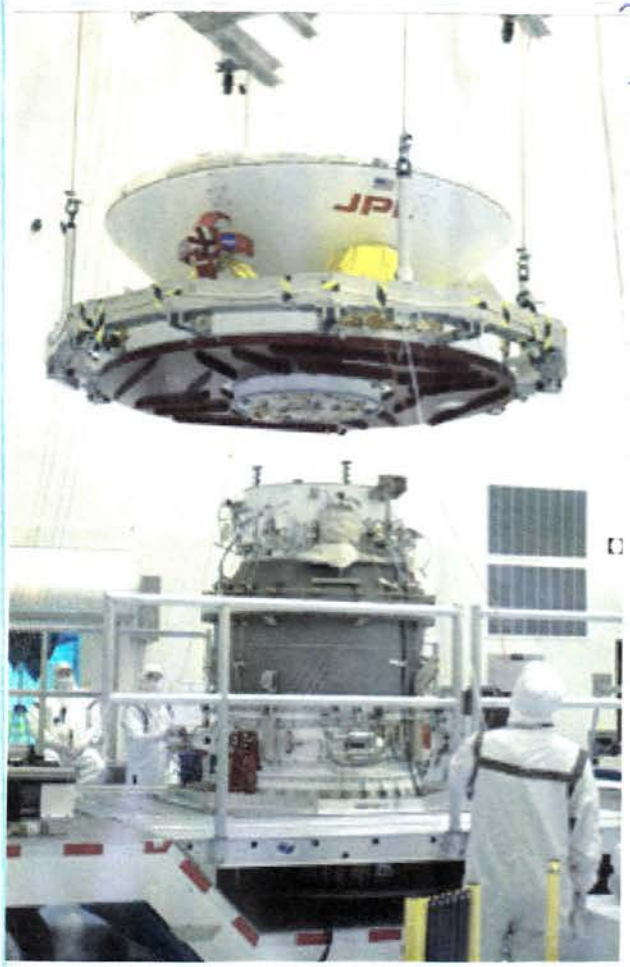

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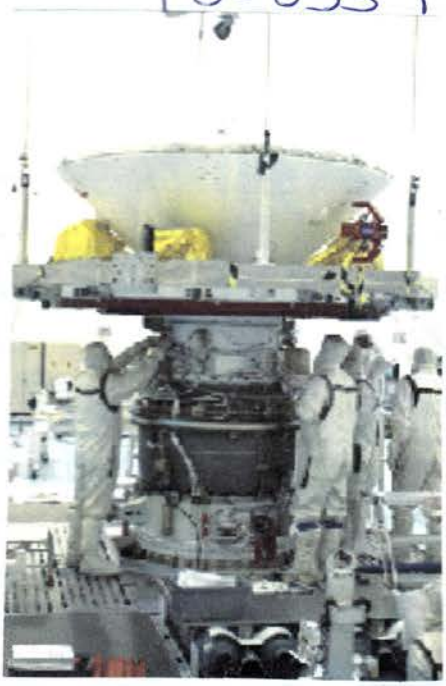

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FLORIDA TODAY : 01 JUNI 2003.

NASA PRIMED FOR MARS.

CAPE CANAVERAL - In Roman mythology, Mars is the god of war. In recent years, he has lashed out at humanity's robotic representatives. Of about 30 orbiting and landing spacecraft sent to Mars, approximately 20 failed. The space wreckage includes NASA's previous lander, the Mars Polar Lander, which crashed into the surface in 1999. The same year, the Mars Climate Observer failed to make it into orbit around Mars. And Japan's Nozomi orbiter, now en route to Mars, was hit by a solar storm during an Earth flyby last year, damaging its communications and power systems. It's unclear how it will perform when it gets to Mars. But NASA is about to fight its way back to the Red Planet, this time with a two-front scientific assault. The first of two identical Mars Exploration Rovers is set to launch from Cape Canaveral Air Force Station on a Delta 2 rocket as early as next Sunday. The second is scheduled to launch June 25. "This is sort of like baseball," Kennedy Space Center Director Roy Bridges said last week. "You're not going to hit a home run every time you get up to the plate." The space agency also has mounted a public relations campaign. Archival coverage of the Pathfinder landing has been a constant staple on NASA TV for the past few months. Public Mars festivals have been held at the Merritt Square mall and Radisson Resort at the Port, as well as other sites across the nation. Meanwhile, America's allies are lending their support. On Sunday, the European Space Agency was scheduled to launch its own mission to Mars, the Mars Express spacecraft with the Beagle 2 lander. But the American space agency still exhibits some caution toward the planet. Dave Lavery, program executive in NASA's Solar System Exploration division, said one of the reasons NASA chose to fly two rovers was that if one of them fails, NASA could still get data from the other one. That sort of fatalist thinking even guided the naming of the rovers. Students have submitted essays suggesting what to call them. Lavery said that the monikers could not be too related. If one rover met an early death at the hand of Mars, the other rover's name had to be able to stand on its own. For example, the name Lewis is usually closely associated with Clark, and vice versa. NASA is scheduled to announce the rover names on Saturday. Until then, they're known as A and B.

Getting into position

After launch, Rover A will fly for seven months to get to Mars. On Jan. 4, it will take a plunge through the Martian atmosphere in an intricate sequence that will involve a parachute and airbag system opening at just the right times to slow the descending spacecraft in the thin atmosphere. Upon impact, the airbags surrounding the lander will cushion the blow. Engineers estimate the rover will bounce for six-tenths of a mile before coming to rest. Then, the airbags will deflate and the lander should right itself if it landed on its side. The landing petals will unfold, and in a perfect Mars, the rover will drive off the lander without a hitch. "The thing that I'm most nervous about is probably all of that unfolding and getting off the lander," said Cornell University Astronomy Professor Steven Squyres, who will oversee the science experiments. "Once the rover is off driving around, it's in its natural environment."

How they stack up

The space agency hasn't successfully landed on Mars since the Pathfinder mission in 1997. But in some sense, NASA never really abandoned its occupation over the fourth planet. Two spacecraft, Mars Global Surveyor and 2001 Mars Odyssey, are currently orbiting Mars, gathering data and snapping pictures. In addition to their other duties, they've scouted out landing sites for the rovers. The twin rovers dwarf their sibling bot. If Pathfinder's Sojourner rover was a remote-controlled car, the Mars Exploration Rovers are riding lawnmowers. Rovers A and B have a mast that supports a set of cameras at about 4 feet high. Its four cameras will provide a three-dimensional view of the surface. Engineers hope that this will provide people with a feeling of what it might be like to be there. By contrast, Pathfinder provided more of a dog's eye view. In addition, the twin rovers are designed roam a bit farther than Sojourner. Each Mars Exploration Rover could go as far as 110 yards a day. That's about as far as Sojourner went during its entire lifespan on Mars. On Pathfinder, the Sojourner rover toted around three cameras and an X-ray spectrometer. The Pathfinder lander had magnets, a camera, windsocks and atmospheric equipment. By comparison, the new Rovers A and B each come equipped with the four cameras on their masts, three spectrometers and a rock grinder. "I think (there) is much more science content on this mission than there was on Pathfinder," rover project manager Peter Theisinger said. He made the comment while clad in a "bunny" suit -- a white coverall suit with only the eyes showing -- to prevent contaminating one of the nearby rovers during a test this spring.

Is bigger better?

Several scientists seemed to favor more of a blanket-bomb approach when it comes to the Red Planet rather than NASA's approach. Future NASA missions will be even bigger and more complex than these $800 million rovers. Baker and others have mentioned that they would prefer to send many tiny, cheaper robots to Mars to study its geology rather than the mega-bots. That way it could send some of them to riskier places on Mars without fear that the team would lose the entire mission and years of work with one disaster. But Baker understands the lure of the bigger, mobile landers. "It's also a little more spectacular to also have the Star Wars-type robot," Baker said.

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FLORIDA TODAY : 01 JUNI 2003.

ROVERS CARRY ONE OUNCE OF PLUTONIUM.

CAPE CANAVERAL - The two Mars rovers primarily will be powered through electricity produced by solar arrays on the tops of their bodies. But small amounts of radioactive material also will keep the rovers running. A launch accident could release some of that material into the environment, Environmental Protection Agency documents show. Each rover will have several Department of Energy-owned radioisotope heater units to keep batteries and electronics warm during the cold martian nights. These units use a total of 1 ounce of plutonium dioxide from plutonium-238. By comparison, 72 pounds of plutonium flew on the Saturn-bound Cassini mission in 1997. In addition, cobalt-57 and curium-244 -- also radioactive -- are installed in two of the science instruments to calibrate them. There is a 1 in 230 chance of a launch accident releasing radioactive materials into the environment. A small group protested the mission's nuclear material in early May.

80901

ASTRONOTES : 2 JUNI 2003.
MARS GOES LOONEY TUNES.

80902

Popular cartoon characters, Marvin The Martian and Daffy Duck will be showcased on official 1st Space Launch Squadron patches for the two upcoming NASA Mars Exploration Rover Missions slated for blastoff this month. The rovers are to be hurled toward Mars courtesy of Boeing-built Delta boosters. The special patches will act as the defining logo, to be worn by Team Delta crews, comprising members from NASA, the United States Air Force, and Boeing. Additionally, the characters get a place of honor in a mission control booth, at an Air Force launch pad, and on crew suits, jackets and mugs. Representatives from the Air Force working with Warner Bros. Consumer Products created the official patch designs for both the MER-A and MER-B missions, one patch featuring Marvin The Martian saluting the Mars Rover and the other, Daffy Duck posed proudly with the American flag. The first rover is slated for dispatch from Florida's Space Coast no earlier than June 8. The second rover is to roar skyward on June 25.

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Rover Launch Delayed

MICHAEL A. DORNHEIM/LOS ANGELES and CRAIG COVAULT/CAPE CANAVERAL

The first of two U.S. Mars Exploration Rovers will be launched at least three days later than planned—no earlier than June 8—following a NASA decision that project managers need at least three extra days to complete critical prelaunch reviews tied to both vehicles.

Part of the delay was to investigate a blown fuse discovered on the spacecraft in mid-May, said Peter C. Theisinger, the Jet Propulsion Laboratory (JPL) Mars Exploration Rover (MER) project manager. Engineers have determined that it will not affect the mission and the spacecraft can be launched as-is. The rest of the delay is due to the general flight approval process taking longer than expected, he said.

The first mission to launch is called MER-A and for months has been slated to use the No. 2 rover (MER-2), so named because it was the second spacecraft to start construction.

The June 8 launch date now gives an 11-day span to the end of the MER-A launch window on June 19. Announced on May 27, the launch slip was the second for the initial rover mission and came just as technicians at Cape Canaveral completed mating the rover and its solid motor upper stage to the Delta first and second stages on Launch Complex 17A. NASA earlier had planned the first MER launch for May 30 until a cable problem forced the initial slip to June 5.

The fuse connects two electrical grounds—the chassis ground, which is all the conductive pieces of spacecraft structure wired together, and the electrical power system ground. The fuse brings the two grounds to the same potential, and is backed up by a 5,000-ohm resistor in parallel. Ideally all the electricity flows in the power system and not through the chassis.

But on Apr. 15 a jolt of current was used to fire a pyrotechnic release to unfold the MER-2 rover solar array to gain access to replace a circuit board to fix the cable problem. Engineers believe the plasma from the pyro shorted the current into the chassis longer than the typical 0.3-millisec. duration, which fried the fuse as the current went back to power ground. They first suspected there was a blown fuse on May 10.

Tests and analysis show no damage coincident with the fuse blowing. One concern is that stray currents between the two grounds will induce noisy voltages on the bus because of the resistor, but engineers have concluded that this is not a problem and no changes are needed to operational procedures, Theisinger said. The purpose of the fuse was to protect rover electronics from chassis shorts during integration and test, and it was kept for flight because tests showed the design had good noise immunity with the fuse both open and closed.

MER-A's arrival at Mars is still scheduled for Jan. 4, 2004, following midcourse maneuvers that will make up for the time lost in prelaunch delays. The MER-1 rover to be carried by the MER-B second mission did not have to fire its solar array pyro to replace the circuit board, and its fuse is intact. MER-B launch date remains at June 25 from Pad 17B on a Delta II equipped with larger 46-in.-dia. strap-on solid boosters like those used previously only on the Delta III. Its launch window for a higher energy trajectory will close on July 15.

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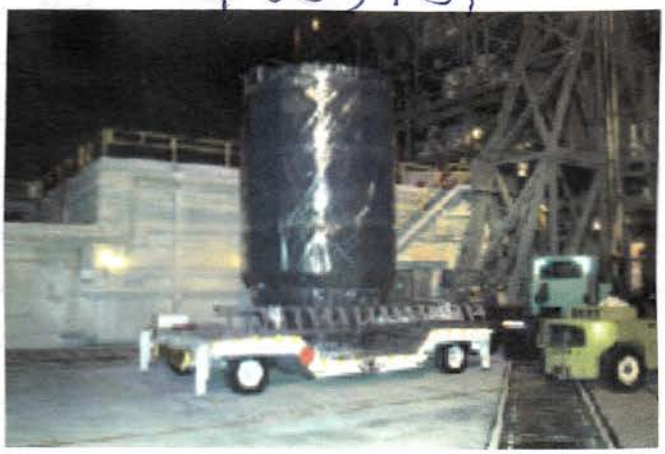

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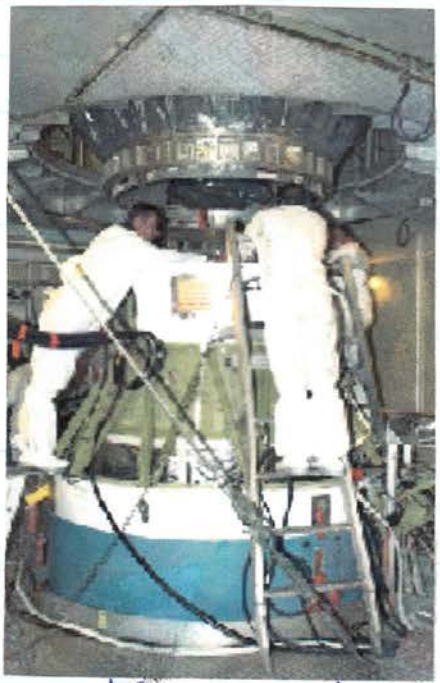

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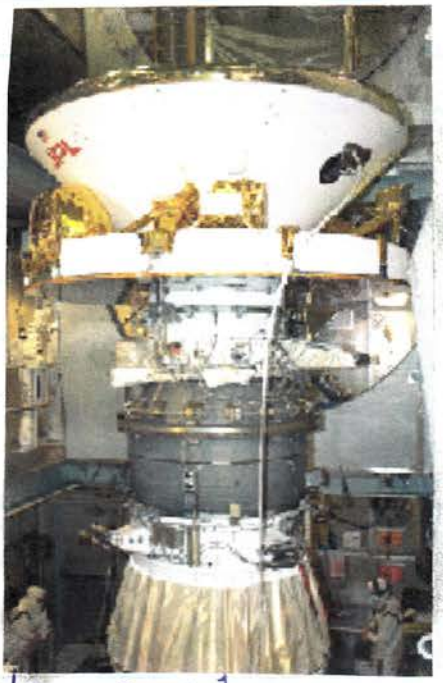

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT JUNE 4, 2003

MISSION: Mars Exploration Rover (MER-A)
LAUNCH VEHICLES: Delta II
LAUNCH PAD: 17-A
LAUNCH DATE: June 8, 2003
LAUNCH TIMES: 2:05:55 p.m. / 2:44:07 p.m. EDT

The Flight Readiness Review for MER-A was held today in the Mission Briefing Room at KSC. At its conclusion, NASA managers affirmed Sunday, June 8 as the launch date for MER-A. The next major activity is thefueling of the Delta second stage on Thursday, June 5 with its complement of storable hypergolic propellants. The payload fairing was installed around the spacecraft last weekend on Saturday, May 31. MER-A was hoisted atop the Delta II rocket at Pad 17-A on May 27. A state of health check was successfully completed on May 28. The Flight Program Verification, an integrated vehicle/spacecraft test and the final major test before the launch, was completed on May 29. The Delta first stage for MER-A was erected on Pad 17-A on April23. The second stage erection was completed on April 28, and the fairing was installed in the white room on April 30. The solid rocket booster erection began on May 13 with the first set of three motors being attached to the first stage. The second set of three was erected on May 14, and the final set was hoisted into position on May 15. The Simulated Flight Test, an electrical test of the vehicle's systems used during powered flight, was successfully completed on May 21.

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FLORIDA TODAY : 05 JUNI 2003.

MARS ROVER-A CLEARED FOR LIFT OFF ON JUNI 8TH AT 2:05 P.M. EDT

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CAPE CANAVERAL - Launch of the Mars Exploration Rover-A is on for 2:05 p.m. Sunday.Mission managers held their Flight Readiness Review on Wednesday, and everything seems to be going according to schedule."Nothing's hanging out there to be resolved," Kennedy Space Center spokesman George Diller said. "The only thing . . . is the weather."Forecasters are predicting thunderstorms between Cape Canaveral and Orlando that afternoon. There is a 40 percent chance of acceptable launch weather Sunday, Monday and Tuesday.
Workers plan to fuel the rocket's second stage today.

BBC : 08 JUNI 2003.

NASA READIES MARS LAUNCH.

80924

Another Mars probe - the second of a series of three spacecraft designed to explore the Red Planet's surface - is due to lift off from Cape Canaveral Air Force Station in Florida, US, on Sunday. The Mer-A's Delta rocket is prepared for launch on Sunday A Delta II rocket will carry the rover - the first of a pair of identical Nasa vehicles - first into Earth orbit and then onwards to Mars. Both rovers are scheduled to reach the fourth planet in January 2004, shortly after the arrival of the European mission which left from Baikonur in Kazakhstan on Monday. The three surface missions take place in quick progression because Mars is currently in a favourable position for a speedy and efficient approach from Earth. The Mars Exploration Rovers are going to Mars to study its geology. They will look for chemical signatures that would confirm abundant water once existed on the planet's surface. The new generation robots are bigger and more powerful versions of Sojourner, the micro-rover that was part of Nasa's Mars Pathfinder mission in 1997. "The instrumentation onboard these rovers, combined with their great mobility, will offer a totally new view of Mars, including a microscopic view inside rocks for the first time," said Ed Weiler, Nasa headquarters associate administrator for space science. They will carry all their instruments with them and will be commanded to go to rock and soil sites of interest by scientists on Earth, some 460 million kilometres away. Only three Nasa space craft have ever touched down successfully on Mars before: the Viking landers of 1976 and Mars Pathfinder. If all goes well, the rovers will head for two places that appear to have once been flooded by water. The British-built Beagle 2 lander, part of the European Space Agency's Mars Express mission, will land at a third location, the Isidis Basin, a few days beforehand. It is a fixed lander and cannot move although it has a mole and a robotic arm to dig into rocks and soil to collect samples. What will the rovers do on Mars? Like Beagle 2, Nasa's rovers will bounce to airbag-cushioned landings at sites offering a balance of favourable conditions for safe landings and interesting science. Mer-A is aimed at the Gusev Crater and Mer-B at a site called Meridiani Planum. "Gusev and Meridiani give us two different types of evidence about liquid water in Mars' history," said Dr Joy Crisp, Mer project scientist at the Jet Propulsion Laboratory in Pasadena. "Gusev appears to have been a crater lake. The channel of an ancient riverbed indicates water flowed right into it. "Meridiani has a large deposit of grey hematite, a mineral that usually forms in a wet environment." The second of the two rovers will launch at the end of June.

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AP NEWS : 08 JUNI 2003.

NASA DELAYS LAUCH OF FIRST TWO MARS ROVERS.

CAPE CANAVERAL - Storms Sunday forced NASA to delay launching a rocket holding the first of a pair of rovers destined for Mars with a mission to search for evidence of water on Earth's neighbor. The launch aboard a Boeing Delta II from the Cape Canaveral Air Force Station was rescheduled for Monday afternoon. The second rover is scheduled for launch later this month, and both vehicles are to arrive at Mars in January. "We sincerely hope it will be the successful beginning to one of the first great 21st century voyages of exploration," NASA Administrator Sean O'Keefe said Sunday. The rovers were officially named on Sunday. Third-grader Sofi Collis, 9, of Scottsdale, Arizona chose the name Spirit for the first rover and Opportunity for the second in a nationwide contest that drew 10,000 entries. "I used to live in an orphanage. It was dark and cold and lonely," said Sofi, who was adopted from Siberia at age 2. "In America, I can make all my dreams come true. Thank you for the spirit and the opportunity." The golf-cart-sized rovers will act as robotic geologists, moving on six wheels. Each is equipped with a pair of panoramic cameras, a camera for close-ups and a drill to sample rocks. Previous missions have shown Mars had water in the past, but scientists want to find out how long the water was there and in what amounts. Scientists believe the water may show that Mars once was able to support life. The rovers' landing sites, on opposite sides of the planet, were chosen for their likelihood of holding evidence of water. Studying the minerals in rocks can tell scientists how the rocks were formed, whether they were ever submerged in water, and whether hot water ever ran over them. The rovers are expected to travel up to 132 feet each Martian day, which is 24 hours and 391/2 minutes long. The rovers' missions are expected to last three months but could run longer. They eventually will shut down as dust builds up on their solar panels. Only 12 out of 30 previous attempts have reached Mars, and only three out of nine attempts have succeeded in landing on the planet. The current rovers are costing $800 million.

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SPACE. COM / MISSION UPDATE

For 12:20 p.m. EDT Sunday June 8:

DELTA 2 LAUNCH IS SCRUBBED FOR TODAY.

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A heavy line of thunderstorms moving toward the launch site has prompted NASA to call off today's attempt to send the Mars Exploration Rover-A, now dubbed Spirit, toward the Red Planet. Winds associated with the strong weather front are forecast to be out of limits and officials need to return the Mobile Service Tower back around the rocket as quickly as possible after emptying the booster's first stage of its RP-1 fuel. NASA launch commentator George Diller reports that another attempt will be made on Monday, although the weather forecast is essentially identical, with only a 40 percent chance of acceptable conditions during the two instantaneous launch times. Conditions are expected to improve slightly on Tuesday. Monday's launch times are 2:02:23 p.m. EDT and 2:40:30 p.m. EDT.

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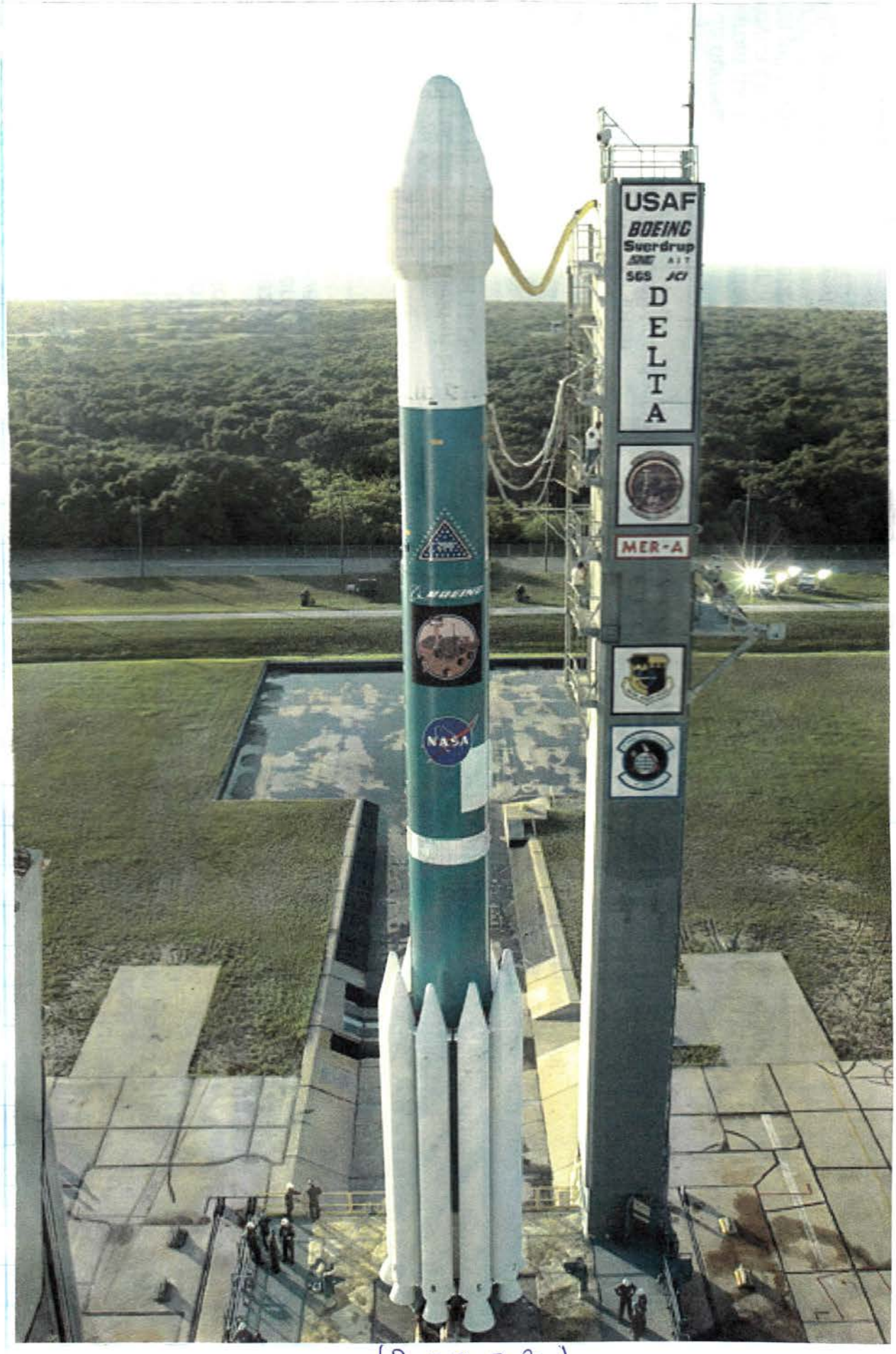

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SPACE.COM : 08 JUNI 2003.

MARS ROVER NAMED SPIRIT AND OPPORTUNITY.

On Sunday, June 8, 2003, NASA Administrator Sean O'Keefe announced that the Mars Exploration Rovers had been renamed Spirit and Opportunity. O'Keefe made the announcement at a press conference along with Sofi Collis, the 9-year-old who had submitted the winning names in a contest sponsored by The Planetary Society and LEGO. Collis, a third-grader from Scottsdale, Arizona, was born in Siberia and had been adopted by an America family at the age two. Her submissions were selected from 10,000 entries."She has in her heritage and upbringing the soul of two great spacefaring countries, to be sure," O'Keefe said. "We have names for these rovers that are extremely worthy of the bold mission they are about to undertake." The names are based on the feelings Collis said she experienced when she first learned she was coming to America. "I used to live in an orphanage. It was dark and cold and lonely. At night I looked up at the sparkly sky. I felt better. I think I could fly there. In America I can make all my dreams come true. Thank you for the spirit and the opportunity," she said. The Name the Rovers contest was open for K-12 American students. Essays justifying the name selections ranged in length from 50 words to 500 words depending on the grade level. "Sofi wrote a moving essay that caught many people's attention in the judging process," Planetary Society Director of Projects Bruce Betts said on the society's website. "Thousands got involved in Mars Exploration through this process. The icing on the cake is that Sofi and her family are absolutely charming." The Planetary Society also ran naming contests for Mars Pathfinder's Sojourner Truth rover, and the Magellan spacecraft.

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CNN : 10 JUNI 2003.

ROVING ROBOT MAY HEAD TO MARS TODAY.

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CAPE CANAVERAL - NASA officials hoped foul weather wouldn't continue to postpone a golf-cart-sized rover's trip to Mars to search for evidence of water. For a second time, the threat of thunderstorms Monday forced NASA to hold off firing the rocket that would carry the first of two such rovers. The launch was postponed until 1:58 p.m. EDT on Tuesday. Scattered thunderstorms were forecast, but there was a 70 percent chance of acceptable weather conditions. Storms and high wind Sunday led NASA to reschedule the flight for Monday afternoon, but the threat of thunderstorms was too great. A second rover is scheduled for launch later this month, and both vehicles are expected to arrive at Mars in January. The rovers act as robotic geologists, moving on six wheels. Each is equipped with a pair of panoramic cameras, a camera for close-ups and a drill to sample rocks. Previous missions have shown Mars had water in the past, but scientists want to find out how long the water was there and in what amounts. Scientists believe the water may show that Mars once was able to support life. Only 12 out of 30 previous attempts have reached Mars, and only three out of nine attempts have succeeded in landing on the planet. The current rovers together cost $800 million.

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(80938)

BBC : 10 JUNI 2003.

ROVER HEADS TO RED PLANET.

(80939)

A Delta II rocket carrying the Spirit vehicle lifted clear of the Cape Canaveral Air Force Station in Florida at 1758 GMT on Tuesday. It was the third attempt at a blast-off - Sunday's and Monday's efforts were postponed because of stormy weather in the launch area. Spirit is identical to the Opportunity rover which will go into space later this month, probably on the 25th. The two astronauts on the International Space Station got a grandstand view of the Spirit lift-off; they were passing close by over North America at the very time the Delta rocket powered into the sky. A camera mounted on the rocket showed images as it sped on its flight path above the Florida coast and through the upper strata of the atmosphere at more than 15,000 kilometers per hour. The American rover missions follow quickly behind that of Europe's Mars Express and Beagle 2 expedition to the Red Planet. The European space craft, now more than one million kilometres from the Earth, left the Russian cosmodrome in Baikonur, Kazakhstan a week ago. Over the next few months Mars and the Earth will be closer than at any time in recorded history, cutting the journey to less than seven months. Spirit and Opportunity were formally given their names on Sunday by nine-year-old Arizona schoolgirl Sofi Collis in a competition. They are going to Mars to study its geology, seeking chemical signatures that would confirm that abundant water once existed on the planet's surface. "The instrumentation on board these rovers, combined with their great mobility, will offer a totally new view of Mars, including a microscopic view inside rocks for the first time," said Ed Weiler, Nasa headquarters associate administrator for space science. "However, missions to Mars have proven to be far more hazardous than missions to other planets. "Historically, two out of three missions, from all countries who have tried to land on Mars, ended in failure. "We have done everything we can to ensure our rovers have the best chance of success," Dr Weiler said. Spirit is due to arrive on the Red Planet in the New Year, a few days after the Beagle 2 probe. It will be joined by the second Nasa rover at the end of January. Only three Nasa space craft have ever touched down successfully on Mars before: the Viking landers of 1976 and Mars Pathfinder. If all goes well, the rovers will head for two places that appear to have once been flooded by water. The British-built Beagle 2 lander, part of the European Space Agency's Mars Express mission, will land at a third location, the Isidis Basin, a few days beforehand. It is a fixed lander and cannot move although it has a mole and a robotic arm to dig into rocks and soil to collect samples. Like Beagle 2, Nasa's rovers will bounce to airbag-cushioned landings at sites offering a balance of favourable conditions for safe landings and interesting science. Spirit is aimed at the Gusev Crater and Opportunity at a site called Meridiani Planum. "Gusev and Meridiani give us two different types of evidence about liquid water in Mars' history," said Dr Joy Crisp, Mer project scientist at the Jet Propulsion Laboratory in Pasadena. "Gusev appears to have been a crater lake. The channel of an ancient riverbed indicates water flowed right into it. "Meridiani has a large deposit of grey hematite, a mineral that usually forms in a wet environment."

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AMBITIEUS VS-PROJECT NAAR MARS START

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In Florida is de Amerikaanse onbemande sonde Spirit gelanceerd. Het tuig, het eerste van twee Mars Exploration Rovers, zal een satelliet in een baan om Mars brengen en een robotwagen laten landen en rondrijden op de planeet.

Eind juni volgt het zusterschip Opportunity met een gelijkaardige opdracht. Beide tuigen zullen op zoek gaan naar water op Mars.

De twee sondes zullen eind dit jaar aankomen nabij Mars. Ook de Europese missie Mars Express en de Japanse sonde Nozomi bereiken dan de rode planeet.

Nu zijn er al twee Amerikaanse sondes in een baan rond Mars.

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Kort buitenlands nieuws

CAPE CANAVERAL NASA heeft een raket gelanceerd richting Mars. Het vertrek is twee keer uitgesteld. De robot aan boord moet bewijzen dat er ooit water was op de planeet. De reis duurt zeven maanden.

22262

CNN : 10 JUNI 2003.

EIGHT-EYED ROBOT BLASTS OFF FOR MARS.

A NASA robot packed with eight cameras, geology instruments and super-rugged wheels roared into space on Tuesday, one of three missions headed to Mars this summer during the most favorable cosmic conditions in centuries. The rover, named Spirit, launched atop a Delta rocket from Cape Canaveral, Florida, following two days of rain delays. An identical twin, named Opportunity, is scheduled to lift off June 25. The droids, which together cost $800 million, are expected to land on opposite sides of Mars in January. Their geologic studies, scheduled to last three months, are designed to find physical evidence of water activity on Mars from billions of years ago, when the planet was thought to have been wetter and warmer -- and possibly inhabited by microbes. "That's where we believe the records of life will be read," said James Garvin, NASA's chief Mars scientist. Mars pull too strong for droid armada Like surfers who have been waiting for the big wave, the spacecraft are riding to the red planet as Mars and Earth make their nearest pass to each other since prehistoric times. As they orbit the sun, the two planets come into proximity every 26 months, offering ideal opportunities to launch Martian missions. But during the alignment this summer, they will pass within 34.7 million miles (55.8 million kilometers), thought to be the closest encounter since Cro-Magnon man ruled the Earth. "Mars is closer to the Earth than it has been in 73,000 years. I find that an amazing number," said Nagin Cox, an engineer at NASA's Jet Propulsion Laboratory at Pasadena, California. Cox and JPL colleagues are working with the Mars Exploration Rover missions. A closer approach won't take place until 2287, according to Sky & Telescope Magazine. The rare alignment is an engineer's dream. It shaves months off the cruise to Mars. Normally such trips take 10 to 12 months, but these two missions need only seven months, according to NASA. Since the planets are closer, the communications link between the rovers and Earth will be shorter, allowing faster transmissions back home. The Mars Exploration Rovers are designed to function as roaming mechanical geologists. "We're close enough and the geometry works out that we have an excellent data return. So that means we can bring more pictures, more information about Mars back to the people of Earth," said Cox. Moreover, NASA is sending larger payloads than during other alignments in 2001 or 2005. The individual rovers weigh 384 pounds (173 kilograms), about four times that of NASA's Pathfinder lander in 1997. Each rover is 4 feet 9 inches high (1.5 meters), 7.5 feet wide (2.3 meters) and 5.2 feet long (1.6 meters) The alignment also attracted the attention of the European Space Agency, which on June 2 sent the Mars Express to the red planet, with an arrival scheduled in December. The mission includes a satellite orbiter and the British-built Beagle 2, a miniature lander. Just reaching the red planet would be a milestone. Of about 30 attempts to reach Mars, only one-third have succeeded. Of nine attempts to land there, only three have succeeded. A lot of people have had bad days on Mars. They don't call it the death planet for nothing. -- Ed Weiler, NASA deputy administrator "A lot of people have had bad days on Mars. They don't call it the death planet for nothing," said Ed Weiler, NASA deputy administrator. NASA has the best track record. All three landings were by U.S. missions. But the U.S. space agency lost two Mars-bound craft in 1999. One presumably crashed landed. And another burned up in the atmosphere because of a mix-up over metric and English measurements.

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SPACE.COM : 10 JUNI 2003.

BOEING DELTA 2 SENDS SPIRIT SOARING TOWARD RED PLANET.

CAPE CANAVERAL - A Boeing Delta 2 rocket has successfully sped NASA's Mars rover Spirit out of Earth orbit to begin a seven-month journey to the Red Planet. Finding a hole in cloudy skies over Florida's Space Coast, the three-stage booster lifted off at 1:58:47 p.m. EDT (1758.47 GMT) Tuesday. Afternoon thunderstorms, so common over the Florida peninsula during the summer months, had forced NASA to call off launch attempts on Sunday and Monday. But conditions remained clear enough Tuesday to allow the shot. During the next 39 minutes the rocket stepped through its launch sequence, much of it broadcast live on NASA TV thanks to presence of a rocketcam bolted to the side of the vehicle. Exactly as planned, Spirit separated from the Delta 2's upper stage having already achieved Earth escape velocity. with this victory behind them, Mars mission managers know they still have a long way to go. Only 12 of humanity's 30 attempts so far to unlock Mars' secrets using robot probes have succeeded. "In Mars exploration we have learned to celebrate success one step at a time," said Orlando Figueroa, NASA's Mars exploration program director. "We know there is much work ahead of us." Spirit is due to arrive at Mars on Jan. 24, 2004. Its twin rover spacecraft, now called Opportunity, is to be launched June 25 and arrive at the Red Planet on Jan. 25, bouncing onto the sandy surface with the help of parachutes, retro rockets and inflated balloons. As now planned, Spirit is targeted to land at Gusev Crater, 15 degrees south of Mars' equator. Opportunity is to touch down at Meridiani Planum, about two degrees south of the equator and halfway around the planet from Gusev. Total cost of the two missions, including launch services, spacecraft hardware and mission operations is about $800 million. NASA's pair of Martian probes will join the already enroute spacecraft of Japan's Nozomi and the European Space Agency's Mars Express, which includes the Beagle 2 lander. Already in orbit over Mars are NASA's Mars Global Surveyor and Mars Odyssey spacecraft. "The present Mars exploration program represents the most intensive scientific assault of any heavenly body since the Apollo-era. We are indeed in the midst of an unprecedented chapter in robotic exploration," Figueroa said. While each of the probes now at Mars and on their way go about their studies in different ways, all are interested in helping to answer the same basic questions. "Getting to answer whether life ever took hold there, understanding its evolution for clues of our evolution perhaps, and our destiny, and setting the stage for possible human exploration makes a compelling and worthy case for the continued exploration of the Red Planet," Figueroa said.

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Wissenschaft

NASA: "Spirit" auf dem Weg zum Mars

Nach zweimaliger Verschiebung hat die US-Raumfahrtbehörde NASA ihren Mars-Landeroboter "Spirit" auf den Weg zum Roten Planeten gebracht.

Die Delta-Rakete mit dem Mars-Rover an Bord hob um 19.58 Uhr MESZ vom Weltraumbahnhof Cape Canaveral in Florida ab. Ende Juni wird die NASA einen zweiten Rover folgen lassen. Beide Roboter sollen den Plänen zufolge den Mars im Januar erreichen und dort nach Wasser suchen.

Der ursprünglich für Sonntag geplante Start war zuvor wegen schlechten zwei Mal verschoben worden.

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AP NEWS : 10 JUNI 2003.

ROVER ON OTS WAY TO MARS TO SEARCH FOR POSSIBILITY OF LIFE.

CAPE CANAVERAL - A rocket holding the first of two Mars rovers blasted off today on a seven-month voyage to the red planet where the golf-cart-sized vehicles will search for evidence that there was once enough water to support life on Mars. The rover named Spirit lifted off from the Cape Canaveral Air Force Station aboard a Boeing Delta II rocket at 12:58 p.m. CDT. Thunderstorms delayed the launch by two days, and launch officials contended with a last-minute communications glitch between stations that will track the spacecraft. The second rover, named Opportunity, will be launched later this month, and both are expected to arrive at Mars in January. Moving on six wheels, the $800 million rovers act as robotic geologists. Each is equipped with a panoramic camera, a camera for close-up views of rocks and a drill to cut into rocks. The data will be transmitted back to Earth. Previous missions have shown Mars had water in the past, but scientists want to find out how long the water was there and in what quantities. Scientists believe the water may show that Mars once was able to support life. The rovers' landing sites, on opposite sides of the planet, were chosen for their likelihood of holding evidence of water. Studying the minerals in rocks can tell scientists how the rocks were formed, whether they were ever submerged in water, and whether hot water ever ran over them. The rovers are expected to travel up to 132 feet each Martian day, which is 24 hours and 39 1/2 minutes long. The missions are expected to last three months but could run longer. The rovers eventually will shut down as dust builds up on their solar panels and they will remain on the planet. Only 12 out of 30 previous attempts have reached Mars, and only three out of nine attempts have succeeded in landing on the planet. NASA revamped its Mars program after the failure of two unmanned missions to Mars four years ago. The space agency has been under intense scrutiny since February when the space shuttle Columbia disintegrated over Texas, killing all seven crew members. A logo patch of that last Columbia mission was attached to both Mars rovers.

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CBS NEWS STATUS REPORT : 10 JUNI 2003.

SPIRIT ROVER BEGINS SEVEN-MONTH CRUISE TO MARS AFTER FLAWLESS LAUNCH.

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CAPE CANAVERAL - NASA kicked off an $800 million mission to Mars today, launching the first of two golf cart-sized robots that will creep across the red planet's surface looking for the geological traces of a warmer, wetter past and the environmental conditions necessary for the evolution of life. After back-to-back weather delays Sunday and Monday, the "Spririt" rover thundered away from the Cape Canaveral Air Force Station atop a Boeing Delta 2 rocket at 1:58:47 p.m. A camera mounted on the side of the rocket's first stage provided spectacular views of the Florida peninsula dropping away below as it thundered toward a preliminary parking orbit. Then, a half-hour after liftoff, a Thiokol Star 48B solid-fuel motor ignited, boosting Spirit out of Earth orbit and onto a 311-million-mile trajectory to Mars. If all goes well, Spirit, named by the third grade winner of a "name the rovers" contest, will slam into the martian atmosphere Jan. 4 after a seven-month voyage. A second rover, named Opportunity, is scheduled for launch June 25. It will arrive at Mars on Jan. 25. Scientists can't wait. Based on data streaming down from two spacecraft currently orbiting Mars, scientists know water once flowed on the martian surface and they know vast amounts of water remain today, locked up in the planet's frigid soil. The question is how long did liquid water exist on the surface and did life have time to evolve? If so, do any pockets of primitive life exist today? "This is going to be humanity's first great voyage of exploration of this century," said Steve Squyres, principal investigator for the Mars Exploration Rovers project. "It is a powerful mission of scientific exploration. "Looking at Mars today, it's cold, it's dry, it's barren, it is not the kind of place you'd think would be suitable for life. And yet when looked from above, you see this compelling evidence that once upon a time conditions were different, it was warmer, it was wetter, we see these dried up river beds and lake beds. What we're trying to do with this mission is determine whether or not the conditions at these places would have been suitable for life." Said NASA science chief Edward Weiler.

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P107 CNNTEXT P107 Wed 11 Jun 06:27:01

CNN NEWS

Robot heads to Mars

A NASA robot packed with eight cameras, geology instruments and super-rugged wheels roared into space on Tuesday, one of three missions headed to Mars this summer during the most favorable cosmic conditions in centuries.

The rover, named Spirit, launched atop a Delta rocket from Cape Canaveral, Florida, following two days of rain delays. An identical twin, named Opportunity, is scheduled to lift off the last week of June.

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FLORIDA TODAY : 10 JUNI 2003

SPIRITED ROVER MARS BOUND.

CAPE CANAVERAL - Less than seven months from now, the world will watch as NASA tries to land its Spirit rover on the surface of Mars. The probe made it past its first space hurdle Tuesday -- safely escaping Earth's gravity. "Finally the Spirit has left the nest and is soaring toward Mars," said NASA Mars Exploration Program Director Orlando Figueroa. Spirit launched on a Delta 2 rocket at 1:58 p.m. Tuesday from Launch Pad17A at Cape Canaveral Air Force Station. "Spirit's going to Gusev!" whooped Cathy Weitz, NASA's Mars Exploration Program scientist, shortly after launch. "It's like a part of your heart is on that rover to Mars," she later said. However, the riskiest leg of the journey is ahead. Before launch, Ed Weiler, NASA's associate administrator for space science, said only 5 percent of his concern applied to the launch. The other 95 percent are concerns about entry into Mars' atmosphere, descent and landing. That's why, on launch day, "You won't see a lot of champagne corks at NASA Headquarters," Weiler said. Out of 30 worldwide missions sent to Mars, just 12 have succeeded. NASA experienced two high-profile Mars mission time NASA tried to land on Mars. Now, the $800-million twin Mars Exploration Rovers will embark on hunts for signs of water. Spirit's landing site, Gusev Crater, is thought to have held a gigantic lake. The next generation of Mars robots will hunt for hints of carbon. Both carbon and water are important signs of life. Before completing a full orbit around Earth, the Delta's second stage fired, sending the probe on its way to Mars. A big antenna at Canberra, Australia, picked up a signal from the spacecraft about 42 minutes after launch. The Mars rover team still has a lot to do before landing on Jan. 4. During its 300-million-mile journey, the spacecraft will fire its engines three times to fine tune its path, putting it on course to land at Gusev Crater. The first engine firing will be scheduled sometime in the next few days, said Pete Theisinger, the rover project manager. And engineers will test equipment and software and go through practice runs during the cruise. Gusev Crater, which is 95 miles across, should look about as dusty as other places NASA has landed, but with half as many rocks, said Matt Golombek, Mars exploration landing site scientist. Rocks, although great for geologists, are considered a hazard for a spacecraft bouncing to a landing. The airbags that will cushion the fall of the rover on the planet have been tested to withstand impacts from rocks that are about 1.5 feet tall. The airbag system was pioneered in the 1997 Pathfinder mission. Spirit will also have to contend with horizontal winds and steep slopes during landing. Two previous launch attempts of Spirit this week were canceled due to afternoon thunderstorms. The thunderstorms that plagued the region for a week stayed away early Tuesday afternoon. Now, workers have to scramble to get the second Mars Exploration Rover, Opportunity, off the ground June 25. The rocket destined to carry Opportunity was protected as the Delta 2 rocketed away from the Neighboring pad. "We've got to hump it to make the 25th," said NASA Launch Director Omar Baez. "There's quite a lot of testing that we've got to do. These two or three days that we had to stand down for the weather really affected us and we weren't able to work much on the other pads. That launch may be delayed several days, Baez said.

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Marsrobot op weg naar Rode Planeet

CAPE CANAVERAL — De Amerikaanse ruimtevaartorganisatie NASA heeft gisteren een raket gelanceerd die de eerste van twee onderzoeksrobots naar de planeet Mars moet brengen. De robots gaan onderzoek doen naar water en (oude) levensvormen op de Rode Planeet.

De lancering was tweemaal eerder uitgesteld wegens slecht weer op Cape Canaveral. Het Europese ruimtevaartbureau ESA stuurde een week geleden ook een raket naar Mars. Aan boord is ook hier een Marslander. De landingen zijn voorzien in december en januari.

Spits; 11-06-'03

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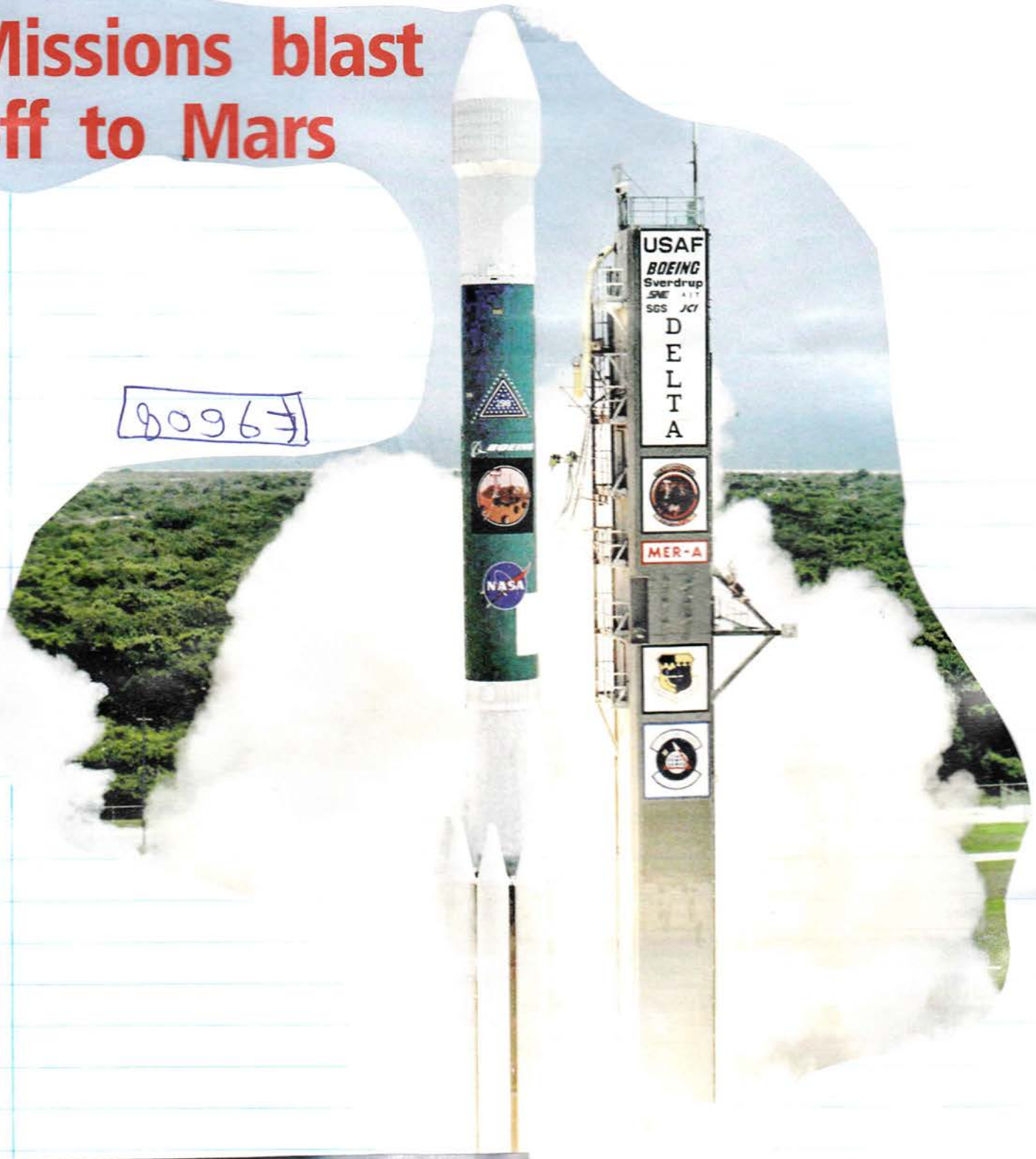
Missions blast off to Mars



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Mars launch success for NASA's Spirit

Just eight days after Mars Express soared to orbit, NASA followed suit with the launch of Spirit, the first of a pair of spacecraft in the Mars Exploration Rover project. The robotic geologist began its seven-month journey to Mars at 1:58:47 pm EDT when its Delta II launch vehicle thundered aloft (see front cover picture) from launch pad 17A at Cape Canaveral Air Force Station, Florida.

The spacecraft separated successfully from the Delta's third stage about 36 minutes after launch, while over the Indian Ocean and at 2:48 pm EDT, flight controllers at NASA's Jet Propulsion Laboratory in California received a signal from the spacecraft via the Canberra, Australia, antenna complex of NASA's Deep Space Network. All systems are operating as expected.

Spirit, targeted to land at Gusev Crater, 15 degrees south of Mars' equator will roam a landing area that bears evidence of water and like the UK's Beagle 2, the rover will examine rocks and soil for clues to whether Mars was a hospitable place for life. The spacecraft's cruise-phase schedule before arriving at Mars around 4 January next year, includes a series of tests and calibrations, plus six opportunities for manoeuvres to adjust its trajectory.

Spirit's twin, Opportunity, was scheduled for launch on 25 June and will be targeted to land at Meridiani Planum, an area with deposits of an iron oxide mineral (grey hematite) about two degrees south of the equator and halfway around the planet from Gusev.

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SPACECRAFT AND EXPENDABLE VEHICLES STATUS REPORT
June 13, 2003

MISSION: Mars Exploration Rover (MER-A)
LAUNCH VEHICLES: Delta II
LAUNCH PAD: 17-A
LAUNCH DATE: June 10, 2003

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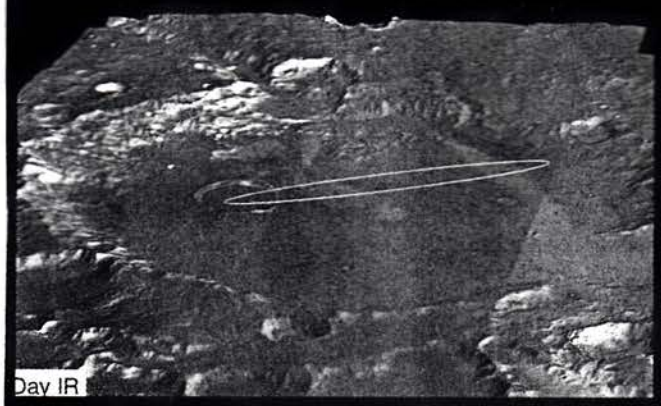
The MER-A Delta II launch vehicle carrying the "Spirit" Mars Exploration Rover was launched successfully from Pad 17-A at Cape Canaveral Air Force Station on Tuesday, June 10. The official liftoff time was 1:58:46.773 p.m. EDT. Communication with the spacecraft through the Deep Space Network indicates that the spacecraft is in good health and on the proper trajectory. There are no issues or concerns with the mission at this time.

Controllers To Point MER-A To Mars

MICHAEL A. DORNHEIM/LOS ANGELES

Mars Exploration Rover engineers were preparing last week for the first trajectory correction maneuver, set for June 20, designed to put the spacecraft on a course for Mars. Telemetry shows the first week of cruise phase has gone well.



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MER-A is aimed at this landing ellipse within Mars' Gusev Crater. It may have been an ancient lake fed by a river channel visible at the far side of the crater.

The mission, known as Mars Exploration Rover-A (MER-A), lifted off from Kennedy Space Center on June 10 for its seven-month trip to Mars (*AW&ST* June 16, p. 61). The second MER-B mission is now undergoing final preparation for launch on June 26. The MER-A rover is named "Spirit" and the MER-B rover "Opportunity."

The MER-A cruise stage star scanner quickly found stars and determined spacecraft orientation, after thrusters reduced spin rate on June 11, to 2 rpm., from the 12 rpm. at separation from the Star 48 upper-stage rocket. The amount of coning motion in the spin is "really small" and much less than the maximum planned, due to good balance and a clean separation, said Richard A. Cook, MER deputy project manager at the Jet Propulsion Laboratory.

Communications on the X-band radio link started at the full 11,800 bits-per-sec. rate using the low-gain antenna on the cruise stage to transmit stored spacecraft status, then dropped to a planned 1,185-bps. rate. Controllers will command a switch to the medium-gain antenna on the cruise stage in several months as MER-A gets further from Earth, Cook said.

Nearly half the battery capacity was used before the spacecraft entered sunlight on June 10, then the solar arrays performed as expected to bring the battery back to full charge. The Freon cooling system that takes heat from the rover electronics buried inside the spacecraft is working properly and showing no signs of leaks, Cook said.

The upper-stage firing was aimed to miss Mars, so the upper stage won't contaminate the planet. The June 20 trajectory correction maneuver (TCM) brings MER-A back on a course to hit the planet. The TCM is a combination of axial and lateral thrusting by the eight 1-lbf. rockets, and the majority of the 47-fps. velocity change is to set the arrival date to Jan. 4 (GMT time) next year, or late Jan. 3, evening in the U.S.

MER-B was mounted on the Boeing Delta II 7925 heavy launcher on June 17 at Cape Canaveral pad 17-B, and the payload fairing is to be installed on June 21. The Flight Readiness Review, also set for June 21, should give approval for the June 26 launch. The MER-A launcher lifted off from pad 17-A.

Missions to the Red Planet

For more spacecraft bound for Mars, visit
www.AviationNow.com/extra

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Mars Beckons

The complex rovers have become NASA's best hope to resurrect the U.S. space program

CRAIG COVAULT/CAPE CANAVERAL

NASA's first Mars Exploration Rover is en route to the red planet on a mission as important to rejuvenating the space program in the wake of Columbia as it is to initiating the first "overland exploration of Mars" in search of watery hideaways for life.

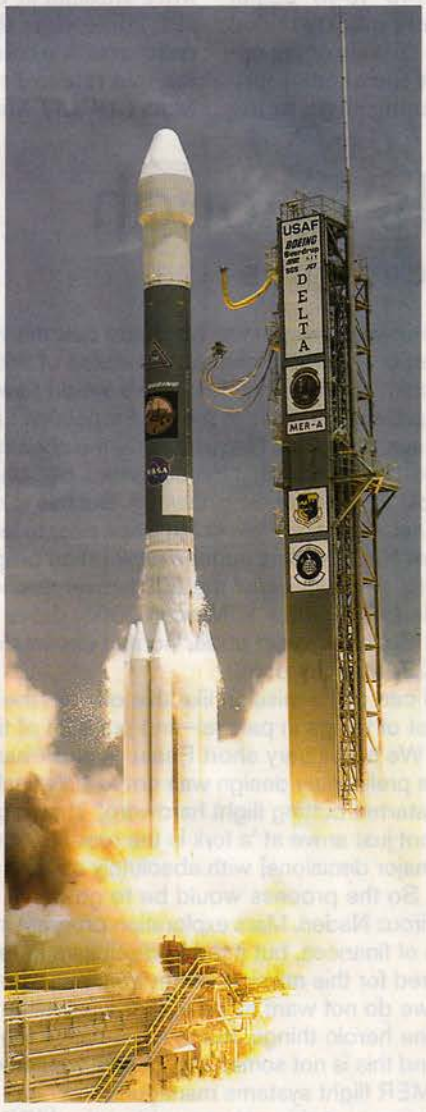
"Never since the Apollo program have we launched such an intensive effort to investigate another heavenly body," said David Lavery, MER program director at NASA Headquarters.

The MERs named "Spirit" and "Opportunity" are in effect mechanical field geologists with an observational and traverse capability more like mechanized versions of the Apollo astronauts who worked on the Moon than either the 1997 Pathfinder or the 1976 stationary Viking landers.

"I will not say money was no object, but this time we will not be accused of scrimping and scrounging on this program," said Ed Weiler, NASA associate administrator for space science.

As the second MER lander is readied for launch next week, 175 engineers and 150 scientists at the Jet Propulsion Laboratory are preparing for nine high-fidelity field tests with simulated rover hardware. Those exercises will refine the coordination of rover commands and surface science operations, said Joy Crisp, MER project scientist at JPL.

With 10 cameras and powerful spectrometers, both were built with more "science mission logic" than the two Viking landers that searched for life in 1976, said Steve Squyres, MER principal investigator.



First Mars Exploration Rover lifts off on Boeing Delta II, which placed it in initial parking orbit, then fired it onto a 24,000-mph. trajectory to Mars.

The MER-A "Spirit" rover lifted off Launch Complex 17A at 1:58:47 p.m. EDT June 10 headed toward a Jan. 4 airbag-cushioned touchdown in an ancient lakebed on the floor of the crater Gusev.

The first rover's launch on board a Boeing Delta II came after two weather delays preceded by nine days of technical-related delays that ate into the critical 26-day launch window for the initial mission.

Launch of the first rover opened the way for the tentatively planned June 25 liftoff of the MER-B rover headed for a Jan. 25 landing on the Meridiani Plains region of Mars.

"If you are looking for life, it's not just having water, it's the perseverance of having water. That's what these missions do uniquely—they are going to tell us about the perseverance of water on Mars," Weiler said. A MER-B launch slip of 1-2 days was being considered, however, due to delays in the MER-A launch. The MER-B spacecraft, for example, for safety reasons could not be attached to its Delta on the adjoining pad until MER-A had safely launched.

Because it is launching later in the Earth/Mars opportunity, MER-B has a trajectory with a 40% greater energy requirement, said Peter Theisinger, JPL's MER project manager. This will require the first use of the new Boeing Delta II Heavy version, with 46-in.-dia. Alliant solid rocket boosters like those used before only on the Delta III.

Both the MER rovers are to land weeks, if not months, before the shuttle returns to flight; and if successful, they will provide a major boost to a space program that will still be under congressional assault for failures that led to the Columbia accident.

JUST AS NASA'S manned program is trying to recover, so is the Mars program that lost the Mars 98 orbiter and lander and saw cancellation of a planned 2001 rover.

"We have totally dismantled the previous Mars program we had in the 2000 time frame," Weiler said. "The previous program was far too aggressive. It did not have the money to do the kind of things that had been planned. In fact, we were supposed to have been doing a sample return mission this year," he said. "It's incredible it was actually thought that could be done! We have now recognized reality."

To maximize MER launch opportunities, JPL and Boeing developed 52 possible trajectories to Mars for the first rover and 42 for the second equating to each spacecraft's launch period.

The first mission launched June 10 had more trajectories because, in early June, when the final fueled cruise stage/rover combination was weighed, it came in several pounds lighter than projected. This allowed Boeing to remove from the third stage ballast that had been added to preset parameters for vehicle performance calculations.

The lighter vehicle gave the MER-A/Delta the ability to achieve velocity and steering targets across five extra days of launch window from June 19-24—an extra cushion against weather or technical delays.

Two instantaneous launch windows toward two different azimuths were possible for each day of the launch period for each rover.

Delta boosters do not have yaw-steering capability, so liftoff timing for MER-A

was dictated by when the rotation of the Earth aligned the pad toward the proper geometric plain for either a 93-deg. or 98-deg. launch azimuth spaced about 40 min. apart.

The launch team had the ability to reload the booster's software within 30 min., allowing a relatively late shift in azimuth. if weather or a technical problem dictated.

Air Force Range Safety engineers also had to be ready to reload their software in that short period, as did tracking station personnel extending from the Cape to Australia. But the backup capability was not needed for the first launch.

MER-A in Delta shroud has Mars entry aeroshell with rover inside, mounted to circular cruise stage sitting atop Star 48 solid rocket motor.

THE FIRST ROVER began its curving 311-million-mi. trajectory to Mars when the planet was 65 million mi. from Earth.

The 254-ton Delta/MER-A vehicle climbed out on 782,000 lb. of thrust generated by its single Rocketdyne RS-27 engine and six of its nine Alliant solid rocket boosters. Then, augmented by the Delta's three air-lit solids, the first stage propelled the vehicle to 65 naut. mi. where the 10,000-lb.-thrust second stage was ignited to complete the climb into an initial 90-naut.-mi. parking orbit. This was about 10 mi. lower than normal Delta parking orbits—a change again designed to give the vehicle more performance to achieve a wider range of trajectories to Mars.

Following a 16-min. coast across the Atlantic, the second stage was reignited off West Africa.

This firing initiated the fastest paced series of events that the rover will see until minutes before touchdown in January. It put the third stage and its rover cargo into a high-energy, 88 X 2,506-naut.-mi. elliptical orbit to provide about 70% of the energy needed for the fast-approaching Earth-escape maneuver.

Critical data on reignition of the second stage were relayed back to the U.S. by a special USAF deployable telemetry station placed on a 110-ft. commercial ship positioned off southwest Africa.

Immediately after second-stage cutoff, six 500-lb.-thrust Atlantic Research spin rockets fired for about 1 sec. to rotate the third stage up to 60 rpm. This was followed 3 sec. later by separation of the second stage. The Thiokol Star 48 third stage is spin-stabilized to hold its guidance targets when firing.

With the proper spin rate achieved and another USAF station in Botswana watching, the 15,000-lb.-thrust third stage was ignited. Roaring in darkness off Africa, it accelerated MER-A to a velocity of 7 mi./sec., hurtling the stage and payload out of Earth's gravity well toward Mars.

After motor burnout, two "yo-yo" despin weights on cables were quickly reeled out several feet from the side of the upper stage to transfer the angular momentum of the spinning stage to the weights, much like ice skaters extend their arms to stop rotation.

As planned, the yo-yo system reduced the spin rate to 12 rpm., followed 5 sec. later by separation of the 2,374-lb. MER-A rover and cruise stage traveling at 24,000 mph.

This key milestone was monitored by a South African-based tracking station that also proved valuable when static interfered somewhat with the critical second- and third-stage-burn data through the USAF mobile sites.

First acquisition of the spacecraft's signal came about 8 min. after separation, 4 min. earlier than planned, through the NASA Deep Space Network antenna at Canberra, Australia. JPL controllers then used the spacecraft's reaction control system to reduce the spin rate to 2 rpm. for the cruise to Mars (*AW&ST* May 26, p. 54).

Once Is Enough

CRAIG COVAULT/CAPE CANAVERAL

The aggressive three-year program to build and test the two Mars Exploration Rovers "was too short of a development for a mission of this complexity" and resulted in a "less efficient" project than managers would have preferred, said Peter Theisinger, MER project manager at the Jet Propulsion Laboratory.

"I have been given everything that I requested for the accomplishment of this mission. And that includes resources from headquarters, personnel from JPL and access to the best people [in planetary engineering]. But this is not the way we would like to do business," Theisinger said here at the Cape prior to launch of the first rover.

The need to recover NASA's Mars surface exploration program after loss of the Mars Polar Lander and cancellation of the 2001 rover mission, coupled with the unusually favorable launch window to Mars in 2003, drove NASA to plan a 34-month development. Such a project under normal circumstances would require 80-90 months (*AW&ST* May 26, p. 58).

"The only way you can pull a mission like this off with the quality that we have achieved is to do a lot of things in parallel—and put a lot of time and a lot of people and hours on it. We had a very short Phase A and Phase B on this project, which means that the preliminary design was not as fully fleshed out as we would have liked when we started cutting flight hardware," Theisinger said.

"Often we would not just arrive at 'a fork in the road,' but rather face four routes to choose from [on major decisions] with absolutely no time to see which individual one panned out. So the process would be to go down on all four routes simultaneously," said Firouz Naderi, Mars exploration program manager at JPL. "That is inefficient in terms of finances, but it did trade dollars for schedule," he said.

"Nothing was spared for this mission, either from headquarters or JPL or other NASA centers, and we do not want to make that a habit," he added.

"The team has done heroic things, but in most cases the people on the team 'have lives' as well—and this is not something that we would want to do over again," said Richard Cook, MER flight systems manager.

The single most important thing that enabled the MER development to be completed in time was that the complex Athena science payload originally planned for the 2001 rover was already developed, allowing that potent science package to be mated with a new rover design, managers here said.

Bericht uit de ruimte
Nummer 37 - 19 juni 2003
Het zonnestelsel in.

De eerste van twee Marsrovers van NASA werd op 10 juni gelanceerd. De Delta-2 raket plaatste de MER-A in een 170 kilometer hoge parkeerbaan om de aarde. Na een kwartier werd de motor van de tweede trap weer ontstoken om de sonde verder te versnellen. Nadat de derde trap de laatste zet had gegeven kwam de MER-A Spirit in een heliocentrische baan terecht. Op 4 januari 2004 zal de Spirit op Mars landen.

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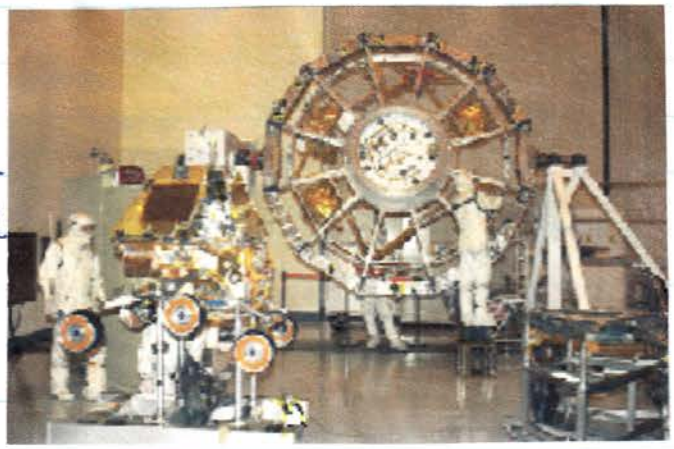

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Science instruments on the two Mars Exploration Rovers have passed their initial post-launch tests based on 200 megabits of telemetry received last month, except for the Mossbauer spectrometer on the MER-2 "Spirit" spacecraft (*AW&ST* July 14, p. 34). All 10 cameras on each spacecraft performed well, as did the alpha particle X-ray spectrometers and miniature thermal emission spectrometers.

AWST: 11-08-'03

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SPACE.COM : 07 AUGUSTUS 2003.

MARS ROVER UPDATE : INSTRUMENT ON SPIRIT MALFUNCTIONS.

LOS ANGELES - An instrument aboard one of the two NASA rovers en route to Mars has malfunctioned, prompting worries it could harm the robot's information-gathering ability, a scientist said Wednesday. If left unfixed, the instrument could still determine the presence of iron-bearing minerals in the rocks and soil on the Martian surface, but not their relative abundance, said Steve Squyres, of Cornell University. Some of that information could be derived from the rover's other instruments, however. Scientists hope that testing the minerals will help solve the riddle of whether Mars was ever a warmer, wetter place capable of sustaining life. "We would be able to extract some science from the data -- not everything, but some," said Squyres, lead scientist on the package of instruments carried on the rover, Spirit, and its twin, Opportunity. Scientists do not understand the cause of the glitch, but have five months to come up with a remedy before the rover lands, Squyres said. Spirit is expected to make a Jan. 3 landing on Mars, followed by Opportunity on Jan. 24. The instrument, called a Mossbauer spectrometer, malfunctioned during tests last week. The National Aeronautics and Space Administration will continue to work on a long-distance fix to Spirit's instrument during the balance of its cruise to Mars. "We will do the best we can to adjust the instrument so it delivers the maximum science," Squyres said. The $800 million pair of rovers otherwise remain in excellent health, according to NASA.

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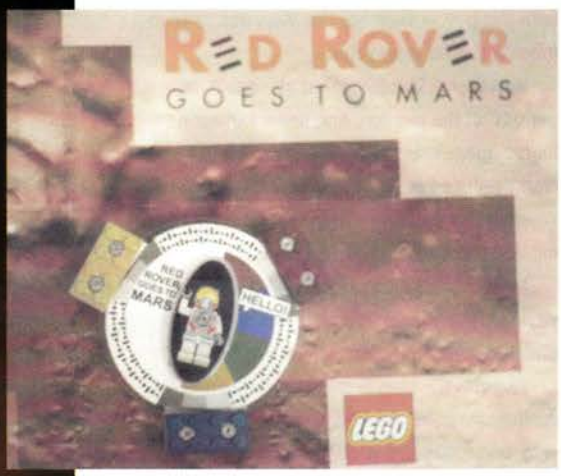
Spaceflight Vol 45 September 2003

Symbolic Mars

by Joel W. Powell

A close-up of the computer chip that holds nearly 30,000 laser-engraved signatures heading for Mars. NASA



'Opportunity' heads to Mars after a successful lift off on 7 July 2003 (NASA). Decorative cover plate (above) for the mini-DVD containing over four million names carried to Mars on each of NASA's twin exploration rovers. Simulated Lego bricks surround "Biff Starling" Astrobot figure for MER-A Hardware courtesy of the Planetary Society. Joel Powell

Commemorative aspects of the current Mars missions

Mars has been a shining beacon in the night skies of Earth this summer as the Red Planet makes its closest approach to Earth in recorded history. The three robotic emissaries on the way to Mars from our world, bear not only the ingenious instruments of the mission scientists, but also symbolic payloads representing the hopes and dreams of millions of Earth-dwellers who wish to reach out and touch another world, if only vicariously.

Names to Mars

Shortly after the Mars Exploration Rovers (MER) were approved, NASA put out the announcement 'Send Your Name to Mars' over the internet by registering at the MER website. For the first time a digital participation certificate with the participants name was offered, which could be downloaded for printing. The names were recorded on a mini-DVD (digital versatile disc) made of silica glass for an extended lifetime of up to 500 years. Before entries were suspended by NASA in late 2002, nearly four million names (including this author) had been submitted to accompany each Rover to Mars.

The world's largest space advocacy group, the Planetary Society, teamed up with Danish toy-maker Lego to produce a protective aluminium cover for the DVDs. The coverplates bear the likeness of the well-known Lego 'Astrobot' figure along with the representations of three authentic Lego bricks. The DVDs were actually attached to one of the landing platform petals, not the rovers themselves.

The DVD project comprises the first educational experiment selected for a NASA planetary mission, 'Red Rover Goes to Mars'. The DVD cover also incorporates magnets to attract dust (provided by the rover's Danish magnet experimenters) and a colour chart to calibrate the cameras before the rovers begin their geological traverses.

Attached directly to the upper surface of each rover is a computer chip etched with the signatures of over 30,000 visitors to the Mars Exploration Rover assembly facility at the Jet Propulsion Laboratory in Pasadena, California. Visitors to JPL, including former astronaut John Glenn and musician Peter Gabriel, signed a guest book, and the signatures were later laser-engraved onto the computer chips. Witness plates with the names of project participants from JPL had previously been attached to the Galileo and Voyager spacecraft.

Spirit and opportunity

The Planetary Society and the Lego company

British artwork on Beagle 2

Europe's Mars Express spacecraft preceeded NASA's first rover mission by eight days. It carries the British-built Beagle-2 lander, named after the ship that carried naturalist Charles Darwin to the Galapogos in 1831, which has two symbolic aspects beyond its famous name. British artist Damien Hirst was persuaded by Beagle-2 team leader at the Open University, Prof Colin Pillinger, to provide a miniature artwork to serve as the calibration target for the lander's camera.

The artwork is one of Hirst's famous 'spot paintings' - 16 brightly coloured dots on a palm-sized aluminium plate that will serve as the colour standard for the surface images. If Beagle-2 is successful, the painting will become the first extraterrestrial art exhibit. ESA also arranged with Italian auto manufacturer and racing sponsor Ferrari to include a few drops of its famous Rosso Corsa red paint in a tiny two cm glass globe on the Mars Express orbiter.

Beagle-2 will signal its touchdown on the Red Planet Christmas Day with a nine-note musical jingle composed by the British pop group Blur. Mars Rover controllers at JPL in Pasadena will have to settle for ordinary electronic tones when their spacecraft reach the surface in January 2004.

One of Damien Hirst's 'spot' paintings will become the first extraterrestrial art exhibit if Beagle 2 is successful. Mike Levers

organised an essay competition for students to suggest names for the Mars Rovers. Nine year old Sofi Collis from Scottsdale, Arizona was the winner, who chose the names 'Spirit' and 'Opportunity' for the two vehicles. Poised and confident in front of the TV cameras, the winsome school-girl read her short essay aloud: "I used to live in an orphanage. It was dark and cold and lonely. At night, I looked up at the sparkly sky and felt better. I dreamed I could fly there. In America, I can make my dreams come true. Thank you for the 'Spirit' and the 'Opportunity'."

Sofi was adopted from a Siberian orphanage at age two by Laurie Collis and was brought to the United States, where she now dreams of becoming an astronaut. School children were clearly motivated by the notion of exploring another planet - Collis' winning entry was chosen from nearly 10,000 submissions.

Martian sundial

As part of the Athena suite of experiments aboard each rover provided by Cornell University, there is a small calibration target for the stereo cameras cleverly designed as a sundial. Originally intended for the now cancelled 2001 Mars Surveyor lander, the sundials were the brainchild of American TV science educator Bill Nye 'The Science Guy'. Nye wondered why the plain metal calibration target on the 2001 lander could not be an actual sundial, and the science team eventually agreed. The sundial was promptly transferred to the Mars rovers with much of the Athena science payload when the 01 lander was cancelled by NASA after the Mars Polar Lander disappeared in 1999.

Each 7.6 cm square sundial features colour squares to calibrate the rover's cameras, and a black centre post (gnomen) to cast shadows that permit adjustment of image brightness back on Earth. There are no hour marks on the sundial: due to the motion of the rovers, hour marks to indicate local time will be added by computer for each observation of the gnomen's shadow.

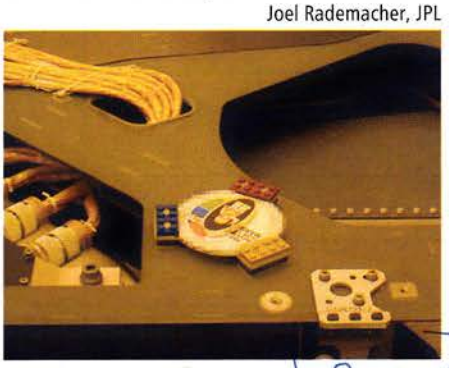
Both sundials bear the inscription 'Mars 2004: Two Worlds, One Sun' along with the name Mars inscribed on the surface in 17 different languages (including ancient Sumerian). An optimistic message to future generations inscribed on the sundial reads (in part), "People launched this spacecraft from Earth in our year 2003... We sent this craft in peace to learn about Mars' past and about our future. To those who visit here, we wish a safe journey and the joy of discovery."

Two final symbolic gestures for MER bear mention. Special banners depicting the rovers were attached to the MER cruise stages just below the aeroshell housing for the landers. The legend on the logos reads 'Mars Exploration Rovers 2003-2004'. Each rover also bears the patch of the STS-107 shuttle mission in honour of the astronauts who died in the Columbia accident.

Connections

NASA's Mars exploration programme lead scientist James B. Garvin, wrote recently in the Orlando Sentinel newspaper, "Mars is indeed terra incognita that may tell us ultimately [that] we are not alone, or, better still, that our origins are traceable to other worlds whose histories can tell us about parts of our long-lost past here on Earth." The search for life in the universe and the urge to explore distant horizons are ideas that resonate within the human heart, and the symbolic aspects of the Mars Rover missions are an attempt to connect individual people (however tenuously) with these noble endeavours.

The DVD is bolted to the petal of the MER lander. Joel Rademacher, JPL



The sundial, which was originally designed for use aboard the cancelled Mars Surveyor Lander mission. NASA/JPL/Cornell

Yuri Malenchenko trouwt in de ruimte

De twee bemanningsleden van Expeditie-7 zijn begin oktober, als jullie deze Astruim krijgen, volop bezig om zich voor te bereiden op hun terug keer naar de aarde. Op 20 oktober zal de Sojoez TMA-3 hun aflossing omhoog brengen. Commandant Yuri Malenchenko zorgde tijdens zijn missie voor de nodige commotie door half juli aan te kondigen dat hij op 10 augustus zou gaan trouwen. Dit zorgde voor de nodige ophef bij NASA en de Russische ruimtevaartorganisatie. Maar er gebeurde natuurlijk meer in de afgelopen maanden aan boord van ISS.

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80995

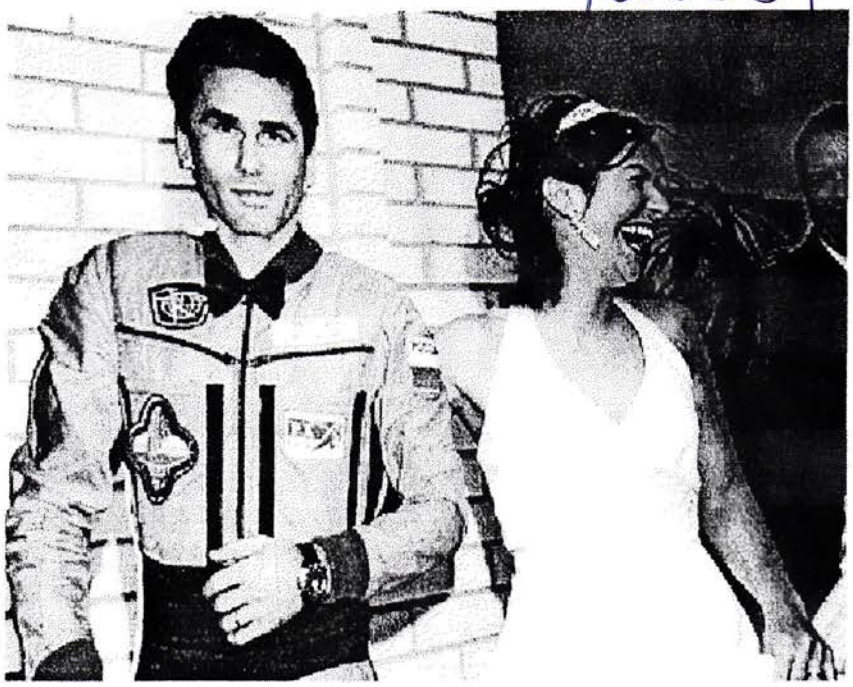
Door JACQUES E. VAN OENE

Op 28 juli was het tijd om een klein feestje te vieren. Op die dag namelijk was het ruimtestation precies 1000 dagen bewoond. Op 2 november 2000 stapte de Expeditie-1 bemanning aan boord van ISS en sindsdien zijn er vele astronauten en kosmonauten gevolgd. De huidige bemanning - Ed Lu en Yuri Malenchenko - hielden een speciale ceremonie om dit heugelijke feit te vieren.

Eind juli maakte NASA officieel bekend wie de Expeditie-8 bemanning zal vormen. Het zijn Michael Foale en Alexandr Kaleri. Zij zullen op 18 oktober samen met de Spaanse ESA astronaut Pedro Duque aan boord van de Sojoez TMA-3 vertrekken voor een ongeveer 200 dagen durende missie. Duque zal op 28 oktober samen met de Expeditie-7 bemanning terugkeren naar aarde. Het hangt er een beetje van af wanneer de Space Shuttle weer mag vliegen of Expeditie-8 met de Shuttle (STS-114) zal worden afgelost of dat er toch weer een twee-persoons aflossing gaat komen in april 2004.

Trouwerij 80996

Tijdens zijn training in Amerika had Yuri Malenchenko (46) in Houston Ekaterina Dmitriev (26) leren kennen en de twee werden verliefd. Yuri en Ekaterina hadden iets speciaals bedacht om hun dag onvergetelijk te maken. Nadat half juli de aankondiging gedaan was dat het paar zou gaan trouwen, vroegen velen zich af of dit wel kon en of NASA en de Russene het wel goed zouden vinden.



Ekaterina moest het doen met een kartonnen Yuri.

De Russen deden er inderdaad van alles aan om Yuri over te halen om het uit te stellen tot december omdat het volgens de Russische wet verboden is voor militaire officieren om met buitenlanders te trouwen (Ekaterina is Amerikaanse nadat ze op 12-jarige leeftijd was geëmigreerd). Maar het paar zette door. 80997

Zo wandelde op zondagmiddag 10 augustus Ekaterina op de muziek van "Absolute Beginners" van David Bowie naar het altaar in het Johnson Space Center in Houston om daar haar ja-woord te geven aan Yuri, die op dat moment op 390 kilometer hoogte net voorbij Nieuw Zeeland het daglicht tegemoet vloog. Ed Lu was de getuige voor Yuri en speelde vanuit het ruimtestation op een orgelmuziek voor het paar. Na de 25 minuten durende ceremonie gaven de twee elkaar kushandjes en konden de 250 genodigde gasten het paar feliciteren. 80998

De verdere maand augustus was de bemanning bezig om de beide Progress vrachtschepen vol te stoppen met afval en dingen die overbodig waren geworden en op 27 augustus werd de Progress-M47 los gekoppeld van ISS, om later te verbranden in de dampkring. Op 29 augustus vertrok vanaf Baikonour de Progress-M48 om op zondagavond 31 augustus met vers voedsel, water, kleding en brandstof vast te maken aan het ruimtestation. Op 4 september koppelde ook de Progress M1-10 zich los van ISS om plaats te maken voor de Sojoez TMA-3 in oktober. *

22276

BOEING NEWS RELEASE : 18 AUGUSTUS 2003

BOEING TO BUILD ELECTRC PROPULSION SYSTEM FOR NASA.

Boeing has been awarded a contract by NASA's Jet Propulsion Laboratory (JPL) to provide the electric propulsion system to be used on the Dawn spacecraft. Boeing Electron Dynamic Devices, Inc. (EDD), located in Torrance, CA., will be responsible for the production of three xenon ion thrusters and two power processor units (PPUs) to be used NASA's latest Discovery program. This electric propulsion system will provide the primary propulsion for the Dawn mission as it travels to Vesta and continues on to Ceres. NASA scientists are hoping to discover how planets are formed and find additional clues as to the origins of the solar system. "EDD is pleased to support NASA - JPL on this important mission," said Chris Stephens, EDD vice president and general manager. "This award represents our customer's confidence in EDD to provide quality electric propulsion as was demonstrated in the highly successful NASA Deep Space One (DS1) mission." The ion thrusters and PPUs for the Dawn spacecraft will be identical to the NSTAR equipment that was qualified and flown on the highly successful NASA Deep Space One mission. The DS1 flight spare ion thruster has achieved more than 30,000 hours of operation and processed more than 235kg of xenon in a life test at JPL. This demonstrates that the NSTAR ion thrusters could meet the Dawn mission requirements of 19,000 hours and 150kg of propellant throughput per thruster. The Dawn ion thrusters and PPUs will be produced and tested at the EDD facility in Torrance with delivery by late 2004. The Dawn mission is currently scheduled for launch in May 2006. Boeing EDD is a leading provider of high reliability products to space and defense customers and the world leader in the development and production of xenon ion thrusters and associated power processor units. EDD serves as an independent merchant supplier under Boeing Integrated Defense Systems. A unit of The Boeing Company, Boeing Integrated Defense Systems is one of the world's largest space and defense businesses. Headquartered in St. Louis, Boeing Integrated Defense Systems is a $25 billion business. It provides systems solutions to its global military, government and commercial customers. It is a leading provider of intelligence, surveillance and reconnaissance; the world's largest military aircraft manufacturer; the world's largest satellite manufacturer and a leading provider of space-based communications; the primary systems integrator for U.S. missile defense; NASA's largest contractor; and a global leader in launch services.

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Phoenix lander selected for 2007 Mars mission

NASA has selected the $325 million Phoenix Mars lander for the 2007 Scout mission to the Red Planet. Phoenix was one of a shortlist of four projects, including a proposed Mars Plane, an atmospheric sample return mission and an orbiter to search for volcanic and organic activity.

Phoenix is the first innovative, competitively selected, lower cost mission in NASA's Mars Exploration Programme, said the agency. It will land in 2009 in one of the high latitude northern regions of Mars, in which the NASA Mars Odyssey orbiter has located a high proportion of water ice by volume within a metre of the surface, to conduct the first sub-surface analysis of ice-bearing materials on another planet.

The surface mission will be led by the University of Arizona and project partners are NASA's Jet Propulsion Laboratory, Lockheed Martin Space Systems, which will build the spacecraft, and the Canadian Space Agency. The craft will be based on the Mars Surveyor Lander 2001, cancelled after the 1999 failure of the Mars Polar Lander. It has been in storage at Lockheed since.

The embarrassing dual failures in 1999 put paid to any thoughts of an early Mars sample return mission, slowed future exploration programmes and reduced funds.

The Phoenix will characterise ice, soil, rock and local atmosphere, using a suite of instruments, including a microscopic imager capable of identifying material down to 10 nanometers, 1000 times less than a human hair.

Phoenix will study ice, soil and rock on the Martian surface. NASA

A powerful robotic arm will be capable of digging one metre into the soil, while imaging with a camera on the arm. Before the landing, a camera will image the touchdown area for reference purposes.

22277

Hubble telescoop in het nauw

Naarmate het langer duurt voordat er weer een space shuttle van start kan gaan, doemen er andere problemen op. Immers weer deze toestellen weer gaan vliegen, zijn ze hard nodig om onderdelen en modules mee te moeten nemen naar de ISS. Er is dan zeker dringend materiaal nodig, zeker na zo'n twee jaren aan de grond gebleven te zijn.
Maar er komt nog een tweede probleem om de hoek kijken: de Hubble ruimtetelescoop. Zo moeten er twee nieuwe wetenschappelijke instrumenten geplaatst worden en de gyroscopen voor de standcontrole zijn ook hard aan vervanging toe, twee van de zes zijn al buiten werking. Deze werkzaamheden kunnen alleen door mensenhanden uitgevoerd worden m.a.w. daarvoor zijn bemande shuttlevluchten nodig. En met die wetenschap komt het toch vreemd over dat sommigen momenteel de discussie op gang brengen om voortaan uitsluitend onbemande shuttle te laten vliegen. Mocht NASA hiertoe besluiten (maar die kans is vrijwel nihil) dan betekent dat het einde van het Hubble tijdperk. Herstelwerkzaamheden zijn op korte tijd noodzakelijk wil de telescoop tot 2011 werkzaam kunnen blijven. De eerste reparatievlucht stond gepland voor begin 2004 maar die datum is al verschoven naar 2005-06. Het wordt tijd dat de shuttles weer de luchtledige ruimte opzoeken.

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Space Telescope by adding another servicing mission to the one that was planned before the shuttle Columbia was lost. But given the shuttle's shaky future, NASA has scotched the idea of using a shuttle to retrieve the telescope for display on the ground. Instead, the agency will consider three options the panel proposed last week: using shuttle astronauts to upgrade the telescope in 2005 and again in 2010—one year before planned launch of the follow-on James Webb Space Telescope; conducting a single servicing mission before the end of 2006 to install two new modular instruments and replace failed gyros; or sending a robot tug to bring the telescope down safely in the ocean once it can no longer make observations. In each case, the goal would be to reduce the gap between Hubble and the Webb operations. The panel, headed by John H. Bahcall of the Princeton-based Institute for Advanced Study, warned of "a major loss of science opportunity" if there isn't at least one more servicing mission. But NASA's shuttle return-to-flight plans rely heavily on inspection, repair and safe-haven capabilities afforded by the International Space Station, and the agency may conclude missions to other destinations are too risky. In that case, the Bahcall panel recommends "fast-track" development of a two-meter space telescope to place the final two Hubble instruments in geostationary orbit by 2010.

AWST: 18-08-2003.

Hubble ruimtetelescoop terughalen naar de aarde is heel gevaarlijk

Dat is de mening van astronauten. De laatste tijd gaan namelijk steeds meer stemmen op om deze ruimtetelescoop in 2010, wanneer zijn opvolger is gelanceerd (zie pag. 20 en 21), met een shuttle terug te halen naar de aarde. NASA staat niet negatief tegenover die plannen. Op dit moment wordt dan ook zeer uitvoerig gediscussieerd en bestudeerd of dit plan uitgevoerd kan worden. Na grondige bestudering van de Hubble telescoop zal het een plaatsje krijgen in Smithsonian Institute in Washington, zodat het publiek deze unieke telescoop, die zo'n grote prestaties heeft geleverd, bewonderen. Of het zover komt, is nog lang niet zeker. Astronauten die reparaties en vervangingen aan deze telescoop hebben uitgevoerd, staan erg huiverig tegenover dat plan. "Heel gevaarlijk" is hun oordeel. Vooral NASA astronaut John Grunsveld die vier shuttlevluchten heeft meegemaakt. Daarvan waren er twee waarbij naar de Hubble werd gevlogen. Volgens hem zullen er naar aller waarschijnlijkheid vier shuttlevluchten moeten worden uitgevoerd, voordat deze telescoop naar de aarde terugkeert. Van tevoren zullen er diverse zware onderdelen verwijderd moeten worden, die dus niet naar de aarde kunnen worden gebracht. Bovendien is de vracht, volgens Grunsveld, te zwaar en loopt de bemanning en de shuttle een groot gevaar dat het geheel tijdens de terugkeer in de dampkring verongelukt. Bovendien gaat dit wel heel veel geld kosten.
In 2005 krijgt het zijn vijfde onderhoudsbeurt en dat is voor de laatste maal. Gebeurt er daarna helemaal niets meer dan zal het in 2013 of 2014 als een ongecontroleerd groot gevaarte de dampkring induiken. Grote delen zullen verbranden en de zware delen zullen ergens op het land of in zee neerkomen.

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22278

Mars Express loses 30 percent electrical power

'We are simply getting to know its personality', said Mars Express project manager Rudolph Schmidt about the worrying faults on the spacecraft en route to the Red Planet.

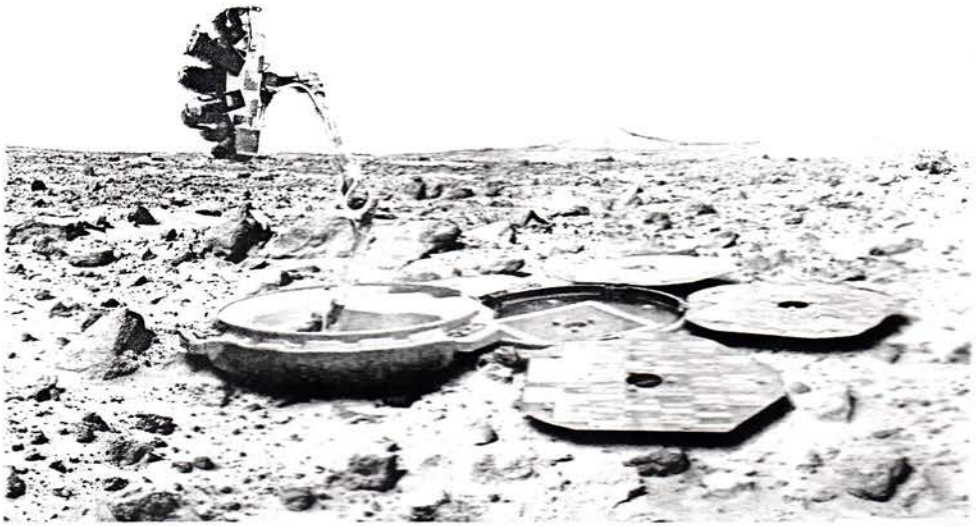
A malfunction in the connection between a power conditioning unit and the craft's solar panels has reduced electrical power by 30 percent. There is also a fault in a solid state mass memory unit.

The European Space Agency (ESA) says the faults 'should not effect any of its goals...it has no effect on the state of the spacecraft and has no impact on the mission during the whole trip to Mars, including orbital insertion phase...even with this power shortage the Mars observation mission will be achievable'.

However, ESA admits that at 'certain short periods' of the mission, engineers will have to juggle operations to prevent overloading the craft's reduced power capability. It is not known whether this problem will get worse as the mission proceeds.

Mars Express also carries the UK's piggyback payload, the Beagle 2 lander. This was yet to undergo its checkout as we went to press.

ESA puts the Mars Express faults down to a glitch 'common on sensitive interplanetary probes subjected to extreme shaking and rocking at lift-off'.



Artist's impression of Beagle 2 on Mars

This illustratates how little engineers fully understand launch dynamics, basically guessing the launch loads and the 'dynamic overshoot' at engine ignition, likened to jumping on scales with a towel over the gauge and guessing what the instant overshoot is.

NASA never fully understood this phenomenon early in the Space Shuttle programme and this explained several major malfunctions with systems and payloads, including the Challenger accident but this has never been mentioned officially.

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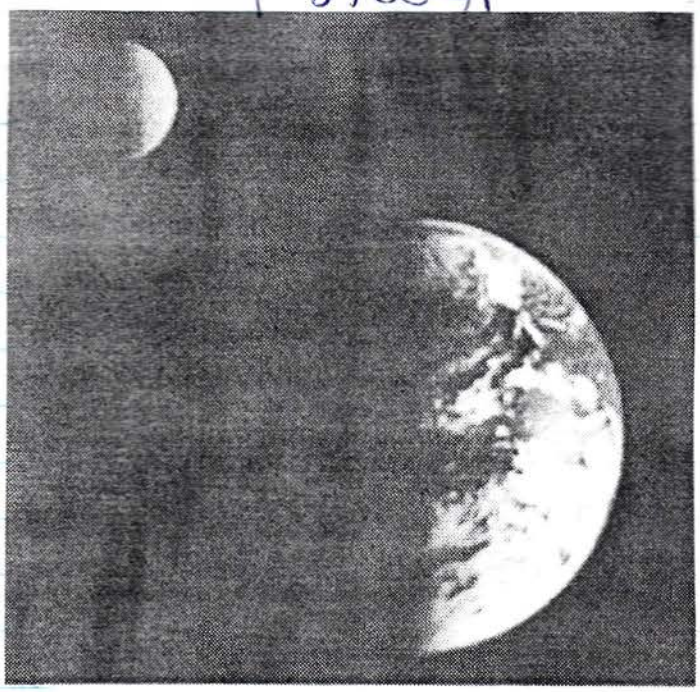
Mars Express doet het geweldig

Op 3 juli 2003 maakte HRSC (High Resolution Stereo Camera) een opname van de aarde en de Maan. Een werkelijk schitterende haarscherpe foto van onze planeet met zijn natuurlijke maan. Nog nooit is door een aards ruimtevaartuig zijn prachtige opname afgeleverd. Technici waren verbaasd over de echtheid van de kleuren: de Stille Oceaan in blauw en de wolken bij de Equator in wit tot lichtgrijs. Dat belooft heel wat als straks de Mars Express op zo'n 250 tot 300 kilometer boven de Rode Planeet draait. We krijgen dan beelden met details van twee meter groot te zien die de gehele wereld zullen doen verbazen. Ook de Omega spectrometer blijkt feilloos te werken. Met dit instrument wordt de moleculaire samenstelling en de aanwezigheid van mineralen in kaart gebracht. Dat gebeurt op een wijze die veruit de beste is tot dusver ooit toegepast. Over de eerste testen zijn ESA wetenschappers bijzonder tevreden.



Deze opname werd genomen op 8 miljoen kilometer van de aarde. Het kleinst zichtbare detail meet altijd nog 75 kilometer.

22279

NODE SATS Tucked away in the cargo compartment of a Russian Progress resupply vehicle set for launch to the International Space Station this week are the first elements of an MIT experiment that will see "satellites" the size of bowling balls maneuvering inside the station's Unity node. Built by Payload Systems Inc., of Cambridge, Mass., the Synchronized Position Hold, Engage and Reorient Experimental Satellites (Spheres) hardware will allow researchers at MIT and elsewhere to test software for docking, formation flying and other multi-spacecraft maneuvers in microgravity. First up to ISS will be a single ultrasonic beacon and a test unit to ensure the experiment won't interfere with other onboard systems. Then in November, another Progress is scheduled to deliver two of the Spheres satellites and four more beacons, with a third satellite to be delivered later. Powered by disposable carbon dioxide canisters for their 12 thrusters and AA batteries for their computers and positioning systems, the satellites will key off ultrasonic pings to find their positions, and then run the test software to maneuver in the spacious node. Each experiment will require about two hours of work by one ISS crewmember, who will set up the hardware, run the sequence with a special laptop, and videotape the maneuvering satellites. Engineers from Payload Systems have tested the satellites on NASA's low-gravity KC-135. Although most of the hardware will be delivered this year, the experiment schedule has been disrupted by loss of the shuttle Columbia and the resulting reduction in ISS crew from three to two.

AWST: 25-08-'03

81008

Maleisië krijgt eerste ruimtevaarder

In de tweede helft van 2005 zal de eerste Maleisiër aan boord van een Sojoez een ruimtevlucht maken. Dit als tegenprestatie van Rusland omdat Maleisië in augustus 18 Russische gevechtsvliegtuigen kocht. Dat betekent wel dat er in allerijl een oproep voor kandidaten gedaan moet worden gevolgd door een selectieprocedure. Daarna volgt nog een intensieve training van twaalf maanden. Het betreft hier een taxivlucht naar het Internationale Ruimtestation.

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NASA NEWS RELEASE: 30 AUGUSTUS 2003

NASA GIVES CHANDRA X-RAY OBSERVATORY LIFE EXTENSION.

NASA has awarded a contract to the Smithsonian Astrophysical Observatory in Cambridge, Mass., to provide science and operational support for the Chandra X-ray Observatory, one of the world's most powerful tools to better understand the structure and evolution of the universe. The contract will have a period of performance from August 31, 2003, through July 31, 2010, with an estimated value of $373 million. It is a follow-on contract to the existing contract with Smithsonian Astrophysical Observatory that has provided science and operations support to the Observatory since its launch in July 1999. At launch the intended mission life was five years. As a result of Chandra's success, NASA extended the mission from five to 10 years. The value of the original contract was $289 million. The follow-on contract with the Smithsonian Astrophysical Observatory will continue through the 10-year mission. The contract type is cost reimbursement with no fee. The contract covers mission operations and data analysis, which includes the observatory operations, science data processing and the general and guaranteed time observer (astronomer) support. The observatory operations tasks include monitoring the health and status of the observatory and developing and up linking the observation sequences during Chandra's communication coverage periods. The science data processing tasks include the competitive selection, planning, and coordination of science observations with the general observers and processing and delivery of the resulting scientific data. There are approximately 200 to 250 observing proposals selected annually out of about 800 submitted, with a total amount of observing time of about 20 million seconds. Chandra has exceeded expectations of scientists, giving them unique insight into phenomena light years away, such as exotic celestial objects, matter falling into black holes, and stellar explosions. X-ray astronomy can only be performed from space because Earth's atmosphere blocks X-rays from reaching the surface. The Chandra Observatory travels one-third of the way to the moon during its orbit around the Earth every 64 hours. At its highest point, Chandra's highly elliptical, or egg- shaped, orbit is 200 times higher than that of its visible- light-gathering sister, the Hubble Space Telescope. NASA's Marshall Space Flight Center, Huntsville, Ala., manages the Chandra program for the Office of Space Science, NASA Headquarters, Washington. Northrop Grumman of Redondo Beach, Calif., formerly TRW, Inc., was the prime development contractor for the observatory. The Smithsonian Astrophysical Observatory controls science and flight operations from the Chandra X-ray Center in Cambridge, Mass.

22280

Nieuwe Sojoez voor toeristen

In 2005 is de nieuwe Sojoez capsule voor toeristen klaar. Dat hebben Space Adventures (V.S.), RSC Energia (Rusland) en de Russische Rosoviakosmos medegedeeld. Naast een Russische commandant is er plaats voor twee betalende passagiers. Kaartjes zijn al beschikbaar voor zo'n 20 miljoen euro. Zijn de liefhebbers geestelijk en lichamelijk goedgekeurd, dan kunnen ze aan een twaalf maanden durende training/opleiding beginnen. Met de aangepaste Sojoez TMA kan vervolgens de reis naar het Internationaal Ruimtestation van start gaan. De gehele vlucht zal tien dagen duren.

Het verblijf in de Sojoez zal wat comfortabeler zijn dan voorheen. Dat is iets wat de eerste ruimtetoerist, Dennis Tito, alleen maar van harte kan toejuichen.

De drie bovengenoemde organisaties zijn het met elkaar eens, alleen NASA moet nog toestemming geven. In het verleden is gebleken dat die weinig enthousiast is. Ook de echte ruimtevaarders staan niet van blijdschap te dansen. Immers, veruit de meesten hebben vele jaren moeten wachten op een toewijzing en heel lang en hard moeten trainen. Beschikt iemand over veel geld, dan koopt hij 'probleemloos' een kaartje. Aan wetenschappelijke bijdrage leveren ze nauwelijks iets van betekenis.

Van de andere kant moet NASA die toeristische vluchten schoorvoetend toestaan. Het is immers de enige manier voor Rusland om zich aan de afspraken voor de bouw van de ISS te kunnen houden. Dat land heeft nu eenmaal nog steeds dat geld hard nodig. Bovendien beschikt Amerika momenteel over geen transportsysteem naar de ISS, zolang de Shuttles op de grond blijven.

We leven nu in een tijd dat toeristen al de ruimte in kunnen. Tito en Shuttleworth waren de eersten. Dit fenomeen is niet meer tegen te houden. Nieuwe toeristen zullen komen al mag Amerika er dan nog zo op tegen zijn. Het is niet meer tegen te houden. Belangstelling is er genoeg: twaalf serieuze kandidaten wachten op hun toelating m.a.w. de komende jaren zit de ruimtetrein voor toeristen vol. Voor jou komt dat goed uit, want dan kun jij nog even doorsparen.

Russia plans dedicated space tourist flight

The first dedicated space tourist flight in history will be launched by Russia in 2005. A ten-day Soyuz TMA mission to the International Space Station (ISS) will carry two fare-paying tourists and a spacecraft commander.

The tourists will book their $20 million seats through the US-based Space Adventures company which has signed a deal with the Russian space agency, Rosaviokosmos, for two flights. About 12 people have applied to Space Adventures and two will be named in about 60-90 days, said the company.

It is possible the second flight will carry just one tourist and two ISS resupply mission crew.

Previous Space Adventures customers were the first space tourist Dennis Tito from the USA and South African Mark Shuttleworth, both of whom flew to the ISS.

Despite the proven demand for Space Adventures tourist flights, Russia will still charge $20 million a ticket . Rosaviokosmos, the Russian space agency, says it hopes to raise up to 50 percent of its annual budget from tourist missions.

Hubble mission extension considered

NASA may continue operating the Hubble Space Telescope (HST) beyond its planned retirement date of 2010 because the Next Generation Space Telescope, named after former NASA adminstrator James Webb, is scheduled for launch in 2011 but faces potential delays.

A NASA-appointed panel has been formed to review the possibilities of extending HST operations, including an orbital boost during a Shuttle mission, to extend its lifetime.

81013

STS-122, the fifth Space Shuttle HST servicing flight will be delayed until at least late 2005 due to the Columbia accident and the mission, to install a Cosmic Origins Spectrograph and a third Wide Field and Planetary Camera, is under review.

The HST was launched in 1990 and four previous servicing missions were flown in 1993-2002.

A mission to return the HST to the Earth for display at the Smithsonian Air and Space Museum in Washington DC is being considered but would need to be accomplished by a Shuttle flying on a 28.5deg, low inclination, complementary orbit.

The majority of Shuttle missions now fly to the International Space Station, in a 51.6deg inclination orbit.

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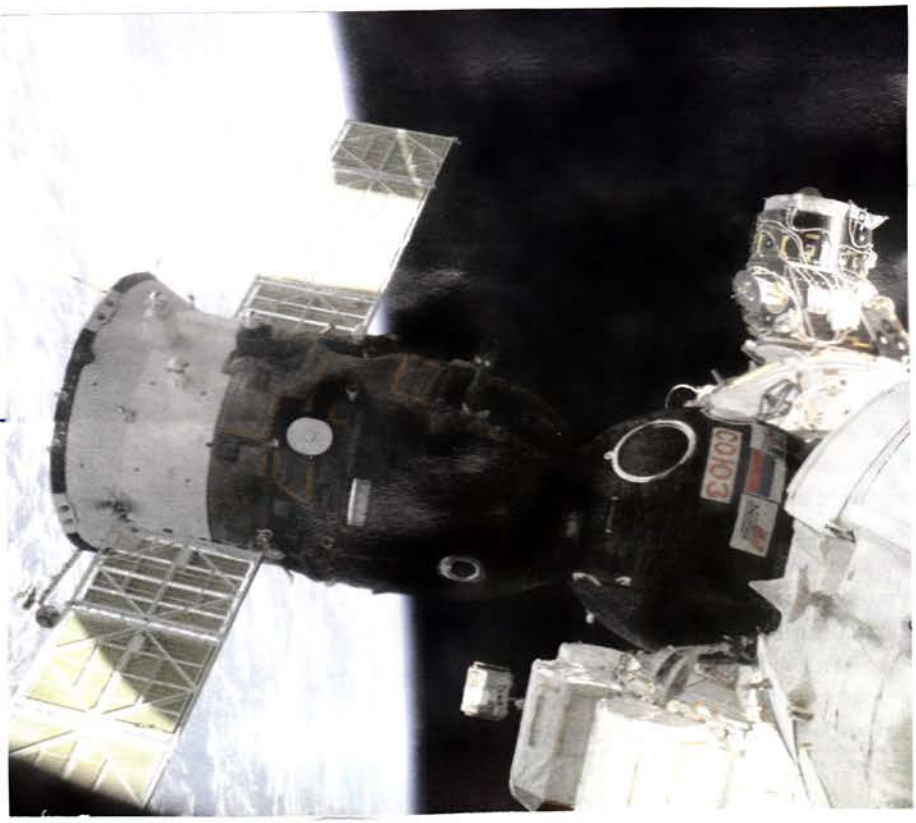

Stardust approaches comet target

81015

NASA's Discovery programme spacecraft, Stardust, which was launched in February 1999, fired its eight thrusters for 24 minutes on 18 June putting it on its final course towards a rendevous with the comet Wild 2 in January 2004.

Stardust will fly through the dust halo of the comet's nucleus collecting tiny particles of what is thought to be some of the solar system's primordial material.

This will be returned to the Earth in January, together with interstellar dust collected en route to the comet, in a small re-entry capsule which will parachute into the US Air Force Utah Test and Training Range.

The ailing Japanese Nozomi craft has made its final Earth gravity-assist fly-by of the Earth at a distance of 6800 miles, placing it onto a course that will rendezvous with Mars early next year.

The craft is intended to enter Martian orbit but there are concerns that technical problems may end the mission prematurely.

22282

SPACEFLIGHT NOW : 28 AUGUSTUS 2003.

RESUPPLY SHIP BOUND FOT THE INTERNATIONAL SPACE STATION.

A fresh load of supplies -- from shoes to rocket fuel -- is headed for the International Space Station following Thursday night's successful launch of Russia's unmanned Progress cargo freighter atop a Soyuz rocket. The three-stage launcher blasted off from the Baikonur Cosmodrome in Kazakhstan at 9:48 p.m. EDT (0148 GMT) as the station flew 240 miles over the south Atlantic Ocean to the east of South America. About nine minutes later, the cargo vessel was deployed into Earth orbit to begin its two-day journey to reach the station. Packed with nearly three tons of cargo, the freighter is the 12th launched by the Russians as part of the International Space Station program. Progress M-48 spacecraft is carrying food, water, oxygen and gifts from home for the station's residents. The outpost is currently occupied by Expedition 7 -- Russian commander Yuri Malenchenko and NASA science officer Ed Lu. The two men, aboard the station since April, were dispatched to the orbiting complex as "care takers" to keep it functioning while NASA's space shuttle fleet remains grounded by the Columbia tragedy. With no shuttles flying until at least spring -- and possibly longer -- the Expedition 8 crew of American commander Michael Foale and Russian flight engineer Alexander Kaleri are preparing to launch aboard a Soyuz capsule in October to relieve Expedition 7. The Progress is carrying shirts, sweaters, shorts, gloves, shoes and more for the Expedition 8 crew to wear during their tour-of-duty, plus dozens of American and Russian food containers. In addition to the usual mix of parts and pieces for station hardware tucked inside every Progess, an Iridium satellite phone and Global Positioning System equipment are aboard for use when Expedition 7 returns to Earth in the Soyuz TMA-2 spacecraft at the end of October. During the TMA-1 landing in May, an internal glitch caused the capsule to switch into a ballistic entry mode. It landed hundreds of miles off course, leading to a long, tense search to find the craft and Expedition 6 crew. Sharing the ride up to the station in October with Expedition 8 will be European Space Agency astronaut Pedro Duque. He will spend a week on the station conducting research before heading back to Earth along with Expedition 7. Some of his science experiments were launched on this Progress. During the freighter's stay at the station, the Progress will transfer a large amount of its propellant into the Russian segment of the complex for use by onboard thrusters. The Progress' docking to the Zvezda service module's aft port is scheduled for 11:45 p.m. EDT (0345 GMT) Saturday night. That port was freed up one day ago when an old Progress was discarded to burn up in the atmosphere.

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Malenchenko (background) and Lu work in the Zvezda Service Module.

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YHOO NEWS : 21 AUGUSTUS 2003.

REPORT ON COLUMBIA CRASH TO BE RELEASED.

CAPE CANAVERAL - The board investigating the space shuttle Columbia disaster plans to issue its 250-page report on what led to the accident next week in Washington. The document, to be released on Tuesday, comes nearly seven months after Columbia disintegrated in the Texas sky, killing seven astronauts. The report will detail all the factors behind the accident and problems over the course of NASA's space shuttle program. The space agency, members of Congress and journalists will receive copies at the same time. A spokeswoman for the Columbia Accident Investigation Board, Laura Brown, said supplemental material will be released separately over the next month. The 13-member board already has determined that a 1 1/2-pound chunk of foam insulation gouged Columbia's left wing during liftoff in January. The foam from the external fuel tank likely created a hole 6 to 10 inches in size that let in the searing gases of atmospheric re-entry during the shuttle's return to Earth on Feb. 1. Columbia was 16 minutes away from a Florida touchdown when it shattered into tens of thousands of pieces. The chairman of the investigation board, retired Navy Adm. Harold Gehman Jr., said last month that the report will place equal blame on the foam strike and related technical problems, and the "systemic failures," namely poor NASA management. Already, five technical recommendations have been made by the board for the shuttle fleet's return to flight. Top NASA officials have promised to heed all of the board's suggestions. The final report will be divided into 11 chapters and include numerous pictures and charts. The investigators had hoped to release their report in late July, just before Congress took off on its monthlong summer recess. But they needed extra time for writing the massive document.

B1023

NASA keen to break 'culture of silence' after Columbia

B1024

The Columbia Accident Investigation Board (CAIB), which was expected to release its STS-107 re-entry accident report in late August, will continue to monitor NASA closely and determine how the space agency has implemented its recommendations.

Responding to the CAIB's intentions, NASA's administrator Sean O'Keefe says that he wants to break a culture of silence within the agency that contributed to the accident.

He admitted that many engineers were afraid to speak out over safety issues, including those that arose during the STS-107 mission after the impact of foam from the external tank (ET) on the left wing of the orbiter during launch in 16 January.

O'Keefe says he wants to create an atmosphere within the agency in which all staff are encouraged to speak out if 'something does not look safe', including the establishment of an 'open' NASA web site.

Similar promises were made after the issue of the report on the 1986 Challenger accident but there is little evidence that much changed within the culture of NASA after this.

Already, it is reported that engineers are resigned to the fact that every Shuttle launch will result in some shedding of foam debris from the ET and are trying to analyse which types of impacts and how much damage will be acceptable.

When the Shuttle's heatshield tiles were designed for the orbiter in the 1970s, it was assumed that no debris would be allowed to hit the thermal protection system but engineers simply learned to live with the fact the every launch released some debris, especially from the ET.

The piece of foam that hit Columbia's left wing at T – 81s during the launch was, at 1.67 lbs, the largest known to have struck the Shuttle. It hit the orbiter at a relative speed of 500 mph while the craft was travelling at Mach 2.5.

NASA is to create an independent Engineering and Safety Centre (ESC) as a result of investigations into the STS-107 Columbia Space Shuttle accident. The ESC, which will be located at the agency's Langley Research Centre, Virginia, will provide comprehensive examination of all NASA programme and projects.

"It will have the capacity and authority to have direct operational influence on any agency mission," said Sean O'Keefe, who remains confident that the Space Shuttle will resume operations in "six to nine months".

He confirmed that foam insulation in the external tank bi-pod region would be replaced by heaters and accepted that NASA management will be heavily criticised in the CAIB report.

The seven crew members were almost certainly aware that the orbiter was in some difficulties before communications ceased. They lived through the disintegration of the left wing, while other parts of the orbiter remained essentially intact during the uncontrolled re-entry.

The fuel cells and life support system were operating but the cooling system had been disabled. The crew cabin would have experienced severe buffeting, while sensor readings indicated severe malfunctions.

The first Space Shuttle mission to be launched since the loss of the STS-107 Columbia crew on 1 February, is unlikely to take place until the summer of 2004, NASA insiders admit. Although a launch window between 11 March and 6 April 2004 is seen as the first opportunity, the agency admits that this is highly optimistic.

Whenever the Space Shuttle - most probably the Atlantis on the STS-114 International Space Station logistics mission, commanded by Eileen Collins - is launched, it will be during the daytime to allow close-monitoring of the vehicle during the ascent and the external tank after it has been jettisoned, to see if its has lost any foam insulation. There will be no more Space Shuttle night launches.

NASA is preparing a solicitation for the procurement of 'proven, flight certifiable sensors' that can detect and quantify damage that may occur to the Space Shuttle's thermal protection system during launch or on-orbit from debris impacts.

The agency is also considering the development of a 17.7 m long, $1.3 billion long boom equipped with cameras to be deployed from the Space Shuttle orbiter after orbital insertion on every mission to inspect the exterior of the spacecraft for any damage. The damage may include gouges, holes or even missing tiles or panels. The imaging system requirements are to detect flaws by 'measuring the three dimensional contour of critical surfaces'. The objective will be 'to measure and quantify six mm diameter and six mm deep' and larger holes or imperfections. Imaging flight hardware and software would need to be available within six to 14 months.

22286

SPACE.COM : 21 AUGUSTUS 2003.

COLUMBIA BOARD REPORT TO BE RELEASED AUG. 26.

CAPE CANAVERAL - The Columbia Accident Investigation Board will release their final report to the public on Tuesday, Aug. 26, as previously scheduled, officials said Thursday. The final report, expected to be about 250 pages and divided into 11 chapters and three appendices, will be available on the CAIB web site at 10 a.m. EDT (1500 GMT) at http://www.caib.us. At the same time, printed and CD-ROM versions of the report will be informally presented to the White House and Congress by board members in Washington, and to the families of the Columbia astronauts in Houston. Tuesday's release of the summary report will be followed in the weeks to come with other volumes that will include such material as supporting information and transcripts of the public hearings. Board chairman Harold Gehman previously said he didn't believe the report would include any dramatically new information about the cause of the Feb. 1 loss of the shuttle and its seven astronauts. The report is expected to blame a piece of insulating foam falling from the external tank and striking the left leading edge of Columbia's wing during launch as the technical explanation for what triggered the disaster during re-entry. The report also is expected to criticize NASA's mission management processes and cite what has become known as "NASA's culture" as a contributing cause of the tragedy. Five interim recommendations already released have dealt with both technical and procedural things NASA should change before resuming shuttle operations. Gehman is scheduled to host a press conference to answer questions about the report at 11 a.m. EDT (1600 GMT) Tuesday. NASA is still finalizing their public affairs plans for the report's release, but it is possible that NASA Administrator Sean O'Keefe will release a statement Tuesday afternoon and then stage a press conference Wednesday after they have had time to read the report. NASA's human spaceflight managers then will discuss their return to flight plans as soon as Thursday, followed the next week by their formal release of a return to flight implementation plan. Finally, that will set the stage for a meeting in early September in Houston by the Stafford Covey Task Group that is independently overseeing NASA's response to the CAIB report.

81025

HOUSTON CHRONICLE : 24 AUGUSTUS 2003.

COLUMBIA PANEL SET TO UNVEIL FINAL REPORT.

81026

Close links to NASA initially caused concerns about the Columbia Accident Investigation Board, but expectations now are high that its final report will be tough and independent. On Tuesday, the 13-member panel will formally outline the causes of the Feb. 1 shuttle tragedy, findings that will give NASA a road map to resume shuttle missions. Experts say the value of the investigation will depend on how critically it looked at NASA's management lapses and policy shortcomings of the White House and Congress. "In my mind, the way to help NASA get on with what it's doing is to give them a very large dose of very tough medicine," said Alex Roland, a Duke University professor specializing in technology history. In the past few months, the board has signaled that it was willing to dig deeply and speak freely. By early this summer, NASA administrator Sean O'Keefe told Kennedy Space Center workers: "It's going to be really ugly." A tough final assessment could prove crucial to the nation's $15.5 billion per year space strategy. If the findings are too forgiving, nobody will debate the future of the shuttle and resources will begin to flow elsewhere, experts say. "Do you fix the problem, or do you fix the problem that created the problem,"said Howard McCurdy, a professor of public administration at American University who has written extensively on NASA. "If the organizational, institutional and cultural systems are not fixed also, the people at NASA are doomed to repeat the procedures that led to Columbia." Investigators believe the spacecraft's Feb. 1 breakup over Texas was triggered by a chunk of fuel tank insulation that broke off and struck the left wing just after launch. Questions over the board's independence arose almost immediately after O'Keefe announced appointments on Feb. 2. Under a pre-existing NASA accident response plan, he asked Harold Gehman, a retired U.S. Navy admiral, to chair a panel that included four military and two civilian aviation safety professionals, NASA's own safety chief and the director of a space agency field center in California. The 1986 loss of the shuttle Challenger was investigated by a 14-member commission appointed by President Reagan and led by William Rogers, an attorney and diplomat. Critics in Congress wanted no less independence for the Columbia investigators. O'Keefe, under pressure, made changes. The board was expanded. NASA's safety chief was dropped. Gehman was granted more leeway and decided to take secret testimony from more than 200 witnesses. The panel enlisted 22 consultants. Gehman, a Virginia resident, chose Houston over Washington as headquarters. O'Keefe lifted a 60-day report deadline. "We have placed ourselves at the top of the investigation," Gehman declared Feb. 12. "Ours is going to be a deep and thorough investigation." The board's first public display of independence surfaced in late February when Gehman asked O'Keefe to reassign several space agency managers. Though he protested, O'Keefe complied. Then, May 14, before NASA's Senate oversight committee, Gehman clashed with O'Keefe, most notably over willingness of agency managers and safety experts to say the foam insulation problem was a maintenance issue rather than a safety threat. O'Keefe acknowledged his agency had misjudged the hazard, but Gehman insisted the problem was more profound: NASA's safety and engineering organizations were inadequately staffed and lacked the authority to raise concerns, he said.

22287

FLORIDA TODAY : 24 AUGUSTUS 2003.

FOAM TESTS HOLD WATER.

WASHINGTON - Tests prompted by the Columbia accident proved the foam insulation surrounding the shuttle fleet's 15-story external fuel tanks can absorb large amounts of water. The finding is significant because foam filled with water or ice would be heavier than dry foam, thus making it capable of doing more damage if it smashed into the shuttle's heat shield during flight. A piece of foam insulation fell off of Columbia's tank during liftoff in January and struck the shuttle's left wing. It apparently caused enough damage to doom the ship during reentry on Feb. 1. The ongoing research at NASA and universities across the country is helping NASA make progress toward fixing the foam debris problem. The problem has plagued the shuttle program since the first launch in 1981. It is an issue that must be resolved before the three remaining shuttles can fly again. "It would be great if, in the end, I could feel I had contributed to eliminating this problem," said Douglas Osheroff, the Nobel Prize-winning physicist from Stanford University who serves on the Columbia Accident Investigation Board and did some of the foam tests in his college lab. Some of the experiments prove what Florida Today reported in March: two types of foam that have most often come off shuttle external tanks are handcrafted in ways that make them vulnerable to soaking up moisture. NASA engineers insisted in the months since the Columbia accident that the foam is impervious to moisture. From the archives: "There's a lot of common wisdom about this foam," Osheroff said. "Sometimes common wisdom is not very wise." The board's final report on the accident, set to be released Tuesday, will criticize NASA for not understanding the material properties of the foam and other shuttle parts. The independent investigators found NASA's faulty assumptions about foam colored its decisions to treat the persistent debris damage as an acceptable risk. Every shuttle ever launched has come home battered by foam insulation, ice and other debris. Florida Today found foam from the tank hit shuttles on at least 74 of 113 missions to date. Incremental fixes were made because the foam was tearing up the critical heat-shield tiles. That extra maintenance needed between flights cost the agency and shuttle contractor time and money. Yet the shuttles kept flying because, early in the program, engineers grew confident the lightweight foam could not possibly do enough damage to down a shuttle. In that context, mission managers decided Columbia would get home safe despite having seen launch films showing a large chunk of foam splattering against the shuttle's left wing. The accident board's report will not recommend specific engineering solutions, but will urge NASA to meet the original shuttle requirement that nothing should hit the orbiter in flight. "We may not be able to recommend that NASA stop any foam loss, but we would like to see them make that the goal," Osheroff said. "It should be a goal to have zero foam coming off the tank." The researchers started out experimenting to find out how the foam failed on Columbia's flight, but they have branched out seeking to identify the causes of the foam shedding in general. Water absorption is becoming one promising line of inquiry. At Marshall Space Flight Center in Alabama, a NASA researcher recreated the environment the foam experiences when the external tank is filled with a half-million gallons of cryogenic fuels, exposing one side of the foam to temperatures as cold as 423 degrees below zero. The other side is exposed to the elements, including the typically humid air at the shuttles' seaside launch pads. In that simulation, the foam did soak up water. Osheroff and some Stanford University graduate students conducted similar tests on a nine-square-inch piece of foam and found it absorbed 4.5 grams of water over 24 hours. "That basically doubles the mass of the foam," Osheroff said. He noted that the tank normally only endures those conditions for six or seven hours before a normal launch, unless there are delays. "One interesting question is can water intrinsically make the foam less strong?" Osheroff said. "If it doubles in mass and it's subjected to these intense vibrations, maybe there's an issue there. The water does not contribute to the strength, that's for sure." NASA discounted any suggestion that the foam that struck Columbia harbored hidden water or ice. Even after the accident, when scientists and other experts noted that similar foams could absorb moisture, NASA said its foam was unique. NASA believed the material's cells are so tightly packed together that even water or gas molecules can't get inside. The foam is sprayed on the tank in layers, mostly by robots, and the outer surface hardens into a rind to further protect it from moist air outside. Florida Today reported in March, however, that the foam is made differently for the area around the bipod, where two struts connect the tank to the orbiter. That area, which is just below the pointy top end of the bullet-shaped fuel tank, is where the vast majority of foam has come loose during 22 years of shuttle flights. Workers shave off that hardened outer rind when applying the foam and cut it to form the aerodynamic bipod ramps. It was a piece of foam from this area that hit Columbia, and NASA plans to eliminate those pieces of foam altogether before returning the remaing shuttles to flight. Workers also poke tiny holes in the foam to vent gas trapped inside air pockets in the insulation. This is done so the gas does not rapidly expand later and blast pieces of foam off the tank. But the holes also provide a way for moisture to get inside the foam. The scientists found that the foam that has not had the rind shaved off "absorbs much less weight," Osheroff said. The piece of foam that hit Columbia could have contained hidden water or ice. It was unusually wet and humid during the 39 days Columbia sat on the launch pad and weather conditions the night the tank was filled with supercold propellants offered a near-perfect environment for moisture and ice to seep into the foam. There is no proof that moisture or ice helped cause the 1.67-pound piece of bipod foam to break free from Columbia's tank. Investigators are convinced the cause was a combination of aerodynamic forces and defects in the foam ramp. What scientists don't know yet is whether the moisture soaking into the foam can weaken it somehow. More work is being done on that issue. NASA's external tank manager did not respond to a request for an interview. "The easy solution is not to let the water in at all," Osheroff said. One suggested solution is "painting" or covering the foam with some kind of waterproof sealant. NASA used to paint the tank white, but stopped to reduce the weight of the shuttle. Osheroff and others are not suggesting "painting" the entire tank, however. They will focus on the relatively small areas most susceptible to absorbing water and foam shedding. "I'm convinced," he said, "that the weight gain due to uptake of water is comparable to the paint." More experimentation is needed on many fronts, Osheroff said. Water is far from the only issue. For example, Osheroff has suggested that NASA study whether problems that crop up during application of the spray-on foam can introduce defects and weak bonds. During the investigation, the board found that some of the foam, including the bipod ramps, contained tiny air pockets, voids and weak bonds. All of those problems can contribute to foam coming off the tank when combined with the intense forces experienced during launch.

81027

SAFETY FIRST **Post-Columbia concerns about space debris and an unusual coincidence drew top NASA managers, including Administrator Sean O'Keefe, into what probably would otherwise have been a routine operational decision on the Hubble Space Telescope earlier this month. On Aug. 2 the telescope's Near Infrared Camera and Multi-Object Spectrometer (Nicmos) shut itself down as it passed through the high-radiation zone known as the South Atlantic Anomaly, an event controllers eventually figured was a single-event upset caused by a stray subatomic particle. But at the same time, the Pentagon's Cheyenne Mountain Operations Center in Colorado Springs was tracking a piece of space debris near the telescope. Mindful that Cheyenne Mountain tracked a piece of debris floating away from Columbia before its Feb. 1 loss on reentry, O'Keefe and Ed Weiler, NASA's associate administrator for space science, ordered a little extra engineering before the delicate telescope instrument was restarted without incident. Hubble hands figure the debris was probably a harmless bit of the telescope's aging foil thermal protection system.**

81028

AWST:

25-08-'03

22288

Top Priority

Returning space shuttles to flight is first task of new NASA Engineering and Safety Center

FRANK MORRING, JR./WASHINGTON

NASA plans to crank up its new Engineering and Safety Center on Oct. 1, setting a safe return to flight for the space shuttle fleet as the center's top priority.

To achieve that goal, its blue-ribbon engineering team will have new clout within the NASA management structure, patterned on U.S. Navy engineering and safety practices, according to former Kennedy Space Center Director Roy Bridges, who was recently named to head both the engineering center and Langley Research Center, Va., where it will be headquartered.

NASA was studying the Navy's approach to nuclear submarine safety even before the Feb. 1 loss of the shuttle Columbia, and Bridges said those Navy "benchmarks" will be incorporated into the NASA center from the beginning. Navy reactor and submarine safety organizations have much more independence from program management than has been the case in NASA's spaceflight organizations (*AW&ST* July 21, p. 31).

At an Aug. 19 press conference, Bridges noted the Columbia Accident Investigation Board (CAIB) "said we don't have enough technical expertise in our independent safety organizations; that that's not robust enough from a technical point of view, that most of that expertise was within the programs. So we're trying to bolster this and even go beyond what we believe those comments indicated and really stand up a very highly technical organization to complement, not only the work that's done in our programs, but also done by the safety and mission assurance organizations that we already have."

Funding for the new center won't be set until the Fiscal 2005 budget is released next February, but Bridges said he expects it will be generous enough to support both a staff of 200-250 and an independent testing program. That would allow the sort of testing the CAIB used to validate its theory that insulating foam falling from Columbia's external tank packed enough of a wallop to damage the orbiter's thermal protection system (*AW&ST* July 14, p. 31).

Shuttle managers discounted the foam as a safety-of-flight issue while Columbia was in orbit on its final mission, based on analysis by a team of Boeing engineers using computer modeling the CAIB has found to be inadequate. Bridges said one early objective of the NASA Engineering and Safety Center (NESC) will be to create "tiger teams" of engineers drawn from across the agency who could tackle a problem quickly. While there probably wouldn't have been time to set up the elaborate test rig like the one the CAIB used, the tiger-team approach would be designed to enhance the level of analysis in future time-sensitive situations.

The center's "Sigma 10" logo is a variation on a Mercury program symbol, expanded to include all 10 field centers.

"We will set up fast response teams that we can put together very quickly, composed of whatever the particular discipline engineers we need, and field that team literally within days of seeing a need to address some problem," said Bridges, a retired Air Force major general and former astronaut. "In this way we [also] hope not to be a burden on the programs."

Day-to-day operations of the NESC will be managed by Ralph Roe, a longtime shuttle engineer who was transferred from Johnson Space Center after the accident (*AW&ST* July 14, p. 32). In addition to a "small staff" at Langley, the center will include both full-time engineers located with the program offices they are monitoring across the agency, and on-call "full-time-equivalent" engineers at all of the field centers who can take part in tiger teams and other special projects. Bridges said one of the first tasks would be to find engineers to work on the shuttle program at Johnson Space Center during the return-to-flight effort.

Roe was in Washington last week getting briefings on the Navy safety practices he will be following, and had scheduled a meeting in Williamsburg, Va., with the chief engineers of the 10 NASA field centers. A second meeting with field center safety and mission assurance chiefs was scheduled this week to continue refining the final shape the center will take.

The NESC will continue to work with the Navy on safety—a practice pushed by NASA Administrator Sean O'Keefe, a former Navy secretary. The agency and the service signed an agreement this month to share data on contractors they both use, and termed it "the first in a series under development to identify and use the 'best of the best' safety and engineering practices of each organization."

The NESC will report to the associate administrator for safety and mission assurance at NASA headquarters, currently former astronaut Brian D. O'Connor, who in turn reports directly to the NASA administrator. While NASA engineers outside the shuttle program have said they didn't expect that their concerns about Columbia's condition during its last mission—reflected in internal e-mail messages—would be acted upon, Bridges said the NESC will give O'Connor strong technical backup at the highest levels of the agency.

"The NESC will represent an independent chain of command for engineers, in that they will provide a way of communicating technical issues completely outside the program that will go to the top," Bridges said.

While the center's initial thrust will be on getting the shuttle flying again—a role Roe was fleshing out in his Williamsburg meetings—NASA plans call for it to be a resource for all of NASA's programs. Bridges said that while it probably would take a couple of years for the NESC to reach that goal, he wanted to try to expand beyond shuttle engineering in the first year.

"I would hope that we could have a broader look even in the first year than just return-to-flight issues," he said. "We're going to be working with our stakeholders and customers here to try to prioritize the type of things that we look at first, but I believe that will be more than just return to flight."

FLORIDA TODAY : 26 AUGUSTUS 2003.

MEMORIES OF FALLEN CREW GROW STERONGER.

CAPE CANAVERAL - In the six months since 8-year-old Iain Clark's mom died on the space shuttle, he has tried to forget. But one night in July, he sat down with his dad and friends in front of the TV and had to relive his last conversation with his mom. In a grainy picture in one corner of the screen, Laurel Salton Clark was waving and, characteristic of her sunny personality, smiling. Iain watched himself in the other image, juxtaposed with hers as they promised to see each other again across the vast video link between the orbiting Columbia and mission control in Houston. "Bye!" his mom said to Iain and his father, Jonathan. "I love you both. Give each other a hug so I can see both your faces." The camera pulled back to show Jonathan and Iain embracing as they said goodbye to Laurel, happy on her first trip to space. "Earth to mom!" Iain exclaimed as their chat ended.

"Space to Iain, space to Iain!" an exuberant Laurel called back. "It really bothered him," his father said of the TV special. "There's always these little reminders." Like other family and friends of the seven lost astronauts, the Clarks have been bombarded since Feb. 1 by recurring images of the fiery streak against the blue sky, by news stories detailing the crew's agony and NASA's mistakes, by endless memorial services whose good intentions are eclipsed by the grief they keep alive. Last month, Iain and Jonathan Clark were flying to Washington for another memorial for Laurel. On the plane, Iain asked why. You promised I wouldn't have to go to any more funerals, he told his dad. For Laurel Clark's family, Willie McCool's parents, Dave Brown's former sweetheart, Ilan Ramon's friends, and the astronauts who knew Kalpana Chawla, Rick Husband and Mike Anderson, the reminders are relentless. Laurel -- Visceral memory At the last minute, Jonathan Clark decided Iain didn't have to go to the dedication of the National Naval Medical Center auditorium outside Washington. Later, he was glad. "They unveiled a very lifelike portrait that I think would have made him sad," he said. A neurologist, Clark has been a flight surgeon and worked in mission control at Johnson Space Center. While most of the astronauts' spouses and loved ones have withdrawn from talking about the disaster, he has become their reluctant voice. "It's kind of my job at NASA now," he said. "I think, like all of the families, we all feel very strongly about our spouses' sacrifice and would like to see that legacy carried on." He's reprioritizing his life, putting aside the adrenalin fix of working with the shuttle. "I just feel like my whole full-time job is really my son," Clark said. His Houston back yard was bleak during the winter of Columbia. But with spring and summer, the colorful flowers his wife planted are blooming, and he laments that Laurel can't enjoy them. "Those things almost trigger a visceral memory of that presence," he said. "They're not painful. They're just poignant reminders of how much you miss somebody." Iain has tried to put the disaster out of his mind. His friends told him terrorist Osama bin Laden shot down the shuttle. Then he saw ABC's TV special on the mission. "He doesn't like to be reminded of the stuff that's painful," Jonathan Clark said. "He was very, very close to Laurel, and he didn't even want her to go," said Laurel's mother, Marge Brown, who lives in New Mexico. "... An 8-year-old is still in the stage of life where they don't want to lose the protection of the adult who's taking care of them." Laurel and Iain decorated the Christmas tree at Brown's house last year. For the Clarks and the Saltons, Laurel's memory will always be wrapped up in Christmas. Laurel, her sister Lynne Salton and her mother exchanged carefully chosen ornaments every year. Last year, Laurel gave Lynne a space shuttle ornament. The day the shuttle disintegrated over Texas, Laurel's brother Jon Salton and his wife flew to Houston from their home in New Mexico, where Jon works for Sandia National Laboratories. When he entered the house where he had once lived with his sister's family, what he saw made him smile. Laurel had been so frantic preparing for her flight, she had left the family's Christmas tree fully decorated. Believing the tree might upset his mother, Jon asked a neighbor to take it down. He climbed into the attic to find boxes for the ornaments. There, he discovered a notebook in which his sister had kept a record of every ornament she had received since the early 1970s. "I kind of laughed, and I kind of cried," he said.

Earlier that day, beside the runway at Kennedy Space Center, Lynne waited for her sister. They had always been close. A grade apart, they backed each other up on the playground. They fought over books. They were friendly competitors on the swimming team. But unlike the astronauts' spouses, who were ushered to crew quarters and then to Houston when it became clear the shuttle wouldn't return, Lynne Salton was simply dropped off at the KSC Visitor Complex. There, she and other relatives of the astronauts saw the flag at half-staff. "We took one look at that, and it was just so emotional. It really hit us, my God, this has really happened," she said. They couldn't get anyone to give them information. Two employees argued over whether she was "family." Laurel's siblings remember her best at the beach house at Kennedy Space Center, where the crew and family gathered for dinner two days before the launch. She was happy and relaxed. Her brother Jon said they talked about seeing each other in a few weeks. "We smiled at each other and walked away," he said. Laurel's mother was at the beach house, too. She was always apprehensive about her daughter's entry into the astronaut corps after stints as a Navy submarine doctor and flight surgeon. "Risk was a not a factor they were mentally dealing with," she said of Laurel and her colleagues. She has made the loss a part of her life. As other families have done, she established memorial funds in her daughter's honor. "I don't know if I really want to recover from it," she said. "I want to remember her as she was. I like to think of her as still very much a part of my life, in a different way." Willie -- Ready for risk The letters, poems and sympathy cards arrive by the hundreds. Handmade gifts. E-mail. Invitations to memorials and tree-plantings. The letters tell Audrey and Barry McCool that they were good parents, that their strength was visible in their son, the astronaut. "You don't want to throw it away," Audrey said. Instead, she's trying to answer the outpouring of sympathy from around the world. She and Barry saw Columbia on its way in, a bright star in the pre-dawn sky over their Las Vegas home. It was the culmination of years of hopes and dreams. A military family, they hardened themselves to risk, and they celebrated the achievements of their children. Willie McCool became a Navy pilot like his father. Barry was serving at sea when he heard Willie had been accepted into the astronaut program. "It was just very, very gratifying that Willie's career was doing as well as it was, and he was probably going to outdo me," he said. "He never wore being an astronaut on his sleeve. He was extremely humble." Willie also was a great father, McCool said, who always made time for wife Lani and their boys. Of Willie's three sons, two took a break from college when the accident happened. The third is in high school. They are doing well, Audrey McCool said, though her husband acknowledges it won't be easy facing Willie's September birthday and Christmas after that. Audrey and Barry teach in the hotel college at the University of Nevada. Willie wanted to be a teacher when he left the astronaut corps, Barry McCool said, so they try to respond when schools want him and Audrey to visit and speak. "These astronauts were really normal people that studied hard in school, that really were not that much different from anybody else," Barry McCool tells children. "They had a lot of drive and initiative to work hard to get where they're at. My message is, don't let anybody tell you no if you really want something." He remembers how joyful the crew was in orbit. He sees Willie doing somersaults, unfettered by gravity. "You remember the good things," he said. "That's what makes it worthwhile." For Ann Micklos of Cocoa, working with Columbia's debris was more than piecing together the remains of a ship she had helped launch 20 times. It was more than something to do after attending three memorial services in three cities in one terrible week. It was the end of a long story.

On Feb. 1, she was waiting for the shuttle on the runway at Kennedy Space Center. As lead airframe engineer for Columbia, she was charged with inspecting the orbiter's tiles when it arrived. The runway was where Dave Brown had first asked her out, when Columbia landed there in 1999. Micklos and Brown dated for more than three years, broke up, but remained good friends. Brown was a Navy pilot and a medical doctor, what colleagues called a "Renaissance astronaut." He worked at Kennedy Space Center while he was in training for what would be his first and last mission. When Micklos worked in Palmdale, Calif., during Columbia's most recent overhaul, Brown would fly in from Houston to visit. One weekend, they decided to meet in San Diego and ended up staying with a friend of Brown's offshore on the USS Constellation, where they watched the "cat and trap" drills -- catapult takeoff and trap landings. "It was just an incredible experience," she said, and not at all what she thought she'd be doing that weekend. "I'm thinking, 'And I thought I was going to the zoo.'" While adventurous, Brown was also humble and considerate. "Everyone was always equal in Dave's eyes, without a doubt," Micklos said. His gymnastics coach at the College of William and Mary, longtime friend Cliff Gauthier, called Brown an "everyday hero." Brown took a snapshot of Gauthier and wife Linda into orbit, then sent the Gauthiers an e-mail from Columbia with a photo attached. It showed the snapshot floating in front of the orbiter windows, with Earth in the background. Brown called it "Gauthiers in space." "Those are just the kinds of things he did in the course of everyday life," Gauthier said. Micklos, like others at the space center, knew early on that a piece of foam had fallen off Columbia's external tank during its Jan. 16 ascent and hit the ship. She hesitates when asked if she was worried on the runway that day. "There's always a concern," she said. "When we had gotten word over the radios that there had been loss of signal of the orbiter, my first reaction was to call Dave's parents," she said. She used her cellular phone to reach Dorothy Brown, gently telling her that Columbia might be lost. The landing support convoy then had to make the distressing drive back down the runway. Employees gathered

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for a quick prayer. "I got up and asked if I could speak," she said. She wanted to convey what Ilan had told her to say in case he did not return. "He told me that he wanted me to let everybody know that he holds no animosity for what has happened," Mirkles said. "He died doing what he loved and holds no regrets." K.C., Rick and Mike – Always a smile. Former astronaut Winston Scott, now executive director of the Florida Space Authority, knew the crew well, especially Kalpana Chawla. She was his crewmate on another Columbia science mission in 1997. K.C., an India-born American citizen, "was our crew 'fun officer,' for lack of a better term," Scott said. When they were in orbit, she always insisted the astronauts play games before they went to sleep. Their mission took place during the Olympics in Nagano, Japan, so K.C. organized an Olympics in space. She did a midair figure-skating routine. One night, Scott and K.C. were flying into Houston on a T-38 astronaut training jet. Bad weather diverted them to New Orleans. They were low on fuel. It was dark. "You don't have much room for error," Scott said. K.C. came through with her usual aplomb, flying the plane while Scott perused information they needed to land. "I was really glad to have her along that night," he said. The astronaut corps is close. Classmates within the corps are even closer. Jim Reilly, who's in training for an upcoming shuttle mission, was in the class of 1995 with Chawla, Michael Anderson and Rick Husband. Rick was "solid," said Reilly. "You could depend on him for anything. He was another guy that was always smiling. In our class, it was always fun to get him going. He had a really sharp mind and a really good sense of humor." Every once in a while, Husband made friends laugh with phrases he'd picked up. He'd imitate a salsa commercial, exclaiming, "Boy, howdy, New York City!" "The feeling is like we lost a family member," said Garrett Booth, executive pastor for Grace Community Church in Clear Lake, Texas, to which Husband and Anderson belonged. Since the accident, Rick's wife, Evelyn, has been speaking publicly at Christian conferences. She is working on a book, "High Calling: The Courageous Life and Faith of Space Shuttle Commander Rick Husband." The men's families "are just incredibly strong in their faith in God, and that's providing them a real strength to move forward," Booth said. Husband sang in the church choir, continuing a lifelong love of music. "He would sing, and out from this guy would come this unbelievable voice," said fellow astronaut Jim Reilly. "It was just the most amazing thing." Reilly and Anderson flew together on a shuttle mission to the Russian space station Mir. He, Anderson and crewmate Joe Edwards teased each other mercilessly. When Anderson tried to stick the nickname "Spuds" on Idaho-born Reilly, they turned it around and made Anderson "Spuds" from then on. "Whenever he was around and you could get him to smile and laugh, he had a really infectious laugh and grin," Reilly said of Anderson. All three of them liked hot cars. Reilly was into American sports cars. Edwards dug Ferraris. Anderson was partial to Porsches. One day, Anderson volunteered to give Reilly a ride on a steamy Houston day. Instead of turning on the air-conditioning, Anderson had the windows of his Porsche rolled down. It was excruciatingly hot. "'Yeah, the heater solenoid is stuck on, and I can't turn it off,'" Anderson told Reilly. "It must have been 120 degrees." The astronauts are looking forward to flying again, with their fallen friends in mind. "I think it's harder on the families in many ways," Reilly said. "They have to deal with an awful lot, the news that's constantly popping up, and just the fact that their loved one is gone. It's not easy for any of us to bury our friends, but it's just the kind of thing you have to do when something like that happens."

Thrust into the spotlight as Ilan Ramon's advisor, Rabbi Zvi Konikov said he's learned a lesson from the first Israeli astronaut. Although he was a secular Jew, Ramon wanted to know how to keep the Sabbath when there's an orbital sunset every 90 minutes. "Regardless of what you're involved in, no matter how important, everyone needs to pause and remember why we're here," said Konikov, rabbi of Chabad Jewish Community Center of the Space Coast. The Satellite Beach rabbi went to Israel for Ramon's funeral and returned for a memorial service in July. Even months after the disaster, thousands of people paid homage. There, the rabbi saw Ilan's wife, Rona. She is infusing their four children with strength and courage. "She's a remarkable person, and you could see it in the eyes of the children," he said. Ramon's mother survived a Nazi death camp at Auschwitz. Her fortitude was reflected in her son. "That was something really great in his character: Despite darkness, we will prevail," the rabbi said. "When he was happy, that's what Ilan was all about at that moment," said John Kanengieter, who helped lead the Columbia crew on a wilderness expedition for the National Outdoor Leadership School. "He lived life in the moment, in the sense that while all this was going on, he could feel very quickly and had a great sense of humor. He had a marvelous twinkle in his eyes, always. He loved his life intensely and his family, I know. He felt a great responsibility, I know, for his country, and at the same time, he was excited to hear it." He was also a good listener. As a leader, he could crystallize a group discussion and transform it into action, Kanengieter said. The 2001 expedition in Wyoming's Wind River Mountains was a turning point for the crew, which trained longer than most because of persistent delays in its 16-day science mission. Living together 24 hours a day for 12 days, seeing one another at their worst and best, they became more like a family than ever before. Kanengieter, director of the school's Professional Training Institute, and fellow guide Andy Cline were part of that temporary family. Kanengieter had lost climbing partners and friends before, but losing seven was beyond his experience. "It's really been a black spring," he said. "You wake up really happy one morning, and three hours later, you feel like you're at the pit of despair," Kanengieter said. "and I think part of that despair is just the despair for the families, the kind of empathetic response we all have."

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CAIB PRESS RELEASE : 26 AUGUSTUS 2003.

COLUMBIA ACCIDENT IVESTIGATION BOARD RELEASES FINAL REPORT.

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WASHINGTON, D.C. - The Columbia Accident investigation Board today presented its final report on the causes of the Feb. 1, 2003 Space Shuttle accident tothe White House, Congress and the National Aeronautics and Space Administration. The CAIB report concludes that while NASA's present Space Shuttle is not inherently unsafe, a number of mechanical fixes are required to make the Shuttle safer in the short term. The report also concludes that NASA's management system is unsafe to manage the shuttle system beyond the short term and that the agency does not have a strong safety culture. The Board determined that physical and organizational causes played an equal role in the Columbia accident - that the NASA organizational culture had as much to do with the accident as the foam that struck the Orbiter on ascent. The report also notes other significant factors and observations that may help prevent the next accident. The Board crafted the report to serve as a framework for a national debate about the future of human space flight, but suggests that it is in the nation's interest to replace the Shuttle as soon as possible as the primary means for transporting humans to and from Earth orbit. The Board makes 29 recommendations in the 248-page final report, including 15 return-to-flight recommendations that should be implemented before the Shuttle Program returns to flight. The report, which consists of 11 chapters grouped into three main sections, was the result of a seven-month-long investigation by the CAIB's 13 board members, more than 120 investigators, 400 NASA and contractor employees, and more than 25,000 searchers who recovered Columbia's debris. Over the next several weeks, the Board expects to publish several additional volumes containing technical documents cited in the report or referenced as part of the investigation, as well as transcripts of the board's public hearings.

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SPACE.COM : 26 AUGUSTUS 2003.

COLUMBIA REPORT FAULT NASA CULTURE, GOVERNMENT OVERSIGHT.

WASHINGTON - Politics, budgets, schedule pressure and managerial complacency all played roles in setting the stage for a drama that began with a breakaway piece of insulating tank foam and ended with the Feb. 1 loss of the space shuttle Columbia and her crew. A throng of reporters traded their cellular phones and other wireless devices shortly after 6 a.m. EDT (1000 GMT) for embargoed copies of the Columbia Accident Investigation Board's (CAIB) long awaited final report. The 248-page report, formally released at 10 a.m. EDT (1400 GMT), lays out in detail what has already been said about what went wrong -- both from a physical and organizational point of view -- and lays out what NASA needs to do before it returns any of its three remaining orbiters to the launch pad.
The Columbia Accident Investigation Board was established within the first 24 hours of Columbia's breakup over the western United States. Within three days of the accident, retired U.S. Navy Adm. Harold Gehman had reported for duty as the board's chairman and was leading an expedition to Texas and Louisiana to tour Columbia's debris field. The cause of the accident was not immediately apparent. By the time the board concluded its five-month investigation, their was little, if any, doubt among investigators about the physical cause of the accident: Columbia attempted to re-enter and land the morning of Feb. 1 with a breach in its left wing inflicted some 16 days earlier by a breakaway chunk of foam 81.7 seconds after liftoff. As Gehman had promised on many occasions since the investigation got underway, the report goes well beyond the root technical cause of the accident and provides an integrated assessment of the cultural, political, and budgetary factors at play. In the weeks leading up to the release of the report, senior NASA managers warned agency personnel that they should brace for a scathing indictment of the NASA culture. On this point, the report delivers. But there is also plenty of blame to go around. "The past decisions of national leaders -- the White House, Congress, and NASA Headquarters -- set the Columbia accident in motion by creating resource and schedule strains that compromised the principles of a high-risk technology organization," the reports says. "The measure of NASA's success became how much costs were reduced and how efficiently the schedule was met. But the Space Shuttle is not now, nor has it ever been, an operational vehicle. We cannot explore space on a fixed-cost basis."
Investigators said they found NASA's human space flight organization to be "in most cases . . . extremely aggressive in reducing threats to safety. But we also know -- in hindsight -- that detection of the dangers posed by foam was impeded by 'blind spots' in NASA's safety culture. But as anticipated the report also heaps considerable blame on NASA's organizational culture and its role in the accident. "The organizational causes of this accident are rooted in the Space Shuttle Program's history and culture, including the original compromises that were required to gain approval for the Shuttle, subsequent years of resource constraints, fluctuating priorities, schedule pressures, mischaracterization of the Shuttle as operational rather than developmental, and lack of agreed national vision for human space flight." The report goes on to say: "the NASA organizational culture had as much to do with this accident as the foam." The board also found echoes of the Space Shuttle Challenger disaster during its investigation of the Columbia accident. Time and time again, investigators were struck by similarities and parallels between the two disasters, though 17 years apart. "For both accidents there were moments when management definitions of risk might have been reversed were it not for the many missing signals -- an absence of trend analysis, imagery data not obtained, concerns not voiced, information overlooked or dropped from briefings," the report says. A 34-page section of the report, "Decision-Making During the Flight of STS-107," recounts the now familiar tale of missed signals, botched imagery requests, and a mission management team largely oblivious to the mortal danger Columbia and her crew were in. The report details eight separate "missed opportunities" during the 16-day flight, from NASA engineer Rodney Rocha's unanswered e-mail four days into the mission asking Johnson Space Center if the crew had been directed to inspect Columbia's left wing for damage to NASA human space flight chief William Readdy's failure to accept the U.S. Defense Department's offer to obtain spy satellite imagery of the damaged shuttle. The report excoriates NASA management decisions during Columbia's last flight. "Perhaps most striking is the fact that management . . . displayed no interest in understanding a problem and its implications. Because managers failed to avail themselves to the wide range of expertise and opinion necessary to obtain the best answer to the debris strike question . . . some space shuttle program managers failed to fulfill the implicit contract to do whatever is necessary to ensure the safety of the crew." Although the report names the key personal who participated in the debris strike decision, the board does not single anyone out for blame or explicitly call for their ouster. "It is tempting to conclude that replacing them will solve NASA's problems," the report says. "However, solving NASA's problems are not quite so easily achieved. People's actions are influenced by the organizations in which they work, shaping their choices in directions that even they may not realize." The report also depicts the broader political scene helped set the stage for the Columbia accident. "The causal roots of the accident can also be traced, in part , to the turbulent post-Cold War policy environment in which NASA functioned during most of the years between the destruction of Challenger and the loss of Columbia," the report says. "The end of the Cold War in the late 1980s meant that the most important political underpinning of NASA's Human Space Flight Program -- U.S.-Soviet space competition -- was lost, with no equally strong political objective to replace it."
The loss of the Soviet Union as a competitor in the human space flight arena made it difficult for NASA to obtain budget increases through the 1990s. But rather than adjust its expectations to the new realities, the Board said, NASA continued to push an aggressive agenda that included the development and construction of the international space station. With no budget increases in sight, NASA's only recourse was to try to do more with less. Enter NASA Administrator Daniel Goldin and his Faster, Better, Cheaper revolution, an era the report

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characterizes as "one of continuous turmoil, to which the Space Shuttle Program was not immune." The watchword throughout the agency in the 1990s was efficiency. For the space shuttle program, as well as a host of other NASA efforts, outsourcing and contract consolidation was part of the solution. "The search for cost reduction led top NASA leaders over the past decade to downsize the Shuttle workforce, outsource various Shuttle Program responsibilities – including safety oversight – and consider eventual privatization of the Space Shuttle Program," the report says. Over the past decade, according to the report, the program's purchasing power was reduced 40 percent and "repeatedly raided" to cover mounting space station bills.

Schedule Pressure

The report also calls into question renewed schedule pressure introduced into the space station and space shuttle programs as Sean O'Keefe was preparing to take over as NASA administrator in January 2002. O'Keefe, who as deputy director of the White House Office of Management and Budget, put NASA on notice in 2001 that it was expected to get the space station program back on track and that a budget bailout was not in the works. Before the end of O'Keefe's first year as NASA administrator, the U.S. space agency had shocked and angered its international partners by cutting key contributions to the space station program in order to eliminate a looming $500 million overrun. The program also began driving toward a very specific completion date: Feb. 19, 2004.

During its investigation, the Board received several unsolicited comments from NASA personnel regarding pressure to meet that date. Board members at first thought the target date for completing the core space station noteworthy but unrelated to the accident. But as the investigation continued, the report says, "it became apparent that the complexity and political mandates surrounding the international space station program, as well as shuttle program management's responses to them, resulted in pressure to meet an increasingly ambitious launch schedule."

The Path Ahead

The report also holds up several organizations as embodiments of the right way to manage risk and exemplars of largely accident-free performance. Those organizations are the U.S. Navy Submarine Flooding Prevention and Recovery (SUBSAFE) program; Naval Nuclear Propulsion programs; and the Aerospace Corporation's Launch Vehicle Verification Process, which supports U.S. Air Force space launch operations. All these organizations, which the board praises for maintaining impressive safety records in the face of considerable technical risk, have at least one major characteristic in common: "they place a premium on safety and reliability by structuring their programs so that technical and safety engineering organizations own the process of determining, maintaining, and waiving technical requirements with a voice that is equal to yet independent of program managers," the report says. NASA has already taken the initial steps toward emulating these organizations. Since the accident, O'Keefe has transferred Kennedy Space Center director Roy Bridges to Langley Research Center in Hampton, Va., where the former astronaut and Air Force general will oversee the establishment of a new safety and engineering center. Bridges said last week he would seek a "generous" testing budget for the center, which is intended to give more clout to NASA's safety watchdogs. In the end, the board concludes that NASA can resume space shuttle operations provided a number of changes are implemented before the first orbiter is rolled out to the launch pad. The major recommendations -- develop an on orbit inspection and repair capability, toughen the wings, prevent the external tank from shedding foam, train more cameras on the shuttle during liftoff and, with the help of U.S. spy satellite agencies, during orbital flight – had already been publicly released before publication of the final report. The report also includes 10 new recommendations that NASA must implement before it returns to flight. Most of them, however, merely add specificity to earlier recommendations. For example, the board goes into greater detail about what kind of camera views NASA should obtain of every launch. Brand new recommendations include establishing a space shuttle flight schedule that is "consistent with available resources," creating an independent Technical Engineering Authority and independent safety program, maintaining more oversight of final tank foam application processes. Another recommendation suggested by the board but not previously formally released, is for NASA to redesign a bolt catcher assembly that CAIB-ordered testing revealed to be possibly too weak to do its job. NASA officials announced a few months ago that they were redesigning this part. The Board also puts forward some longer term goals for NASA, including inspecting and recertifying the shuttle's hundreds of miles of wiring as part of the agency's Shuttle Service Life Extension Program, an effort kicked off earlier this year with the goal of keeping the shuttle in good working order through the end of the decade and beyond.

On these longer term recommendations, the report sounds a sobering note: "Based on NASA's history of ignoring external recommendations, or making improvements that atrophy with time, the Board has no confidence that the Space Shuttle can be safely operated for more than a few years based solely on renewed post-accident vigilance."

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WHITE HOUSE RELEASE : 26 AUGUSTUS 2003.

STATEMENT BY THE PRESIDENT.

"Today the Columbia Accident Investigation Board released its report on the tragic accident that claimed the lives of seven brave astronauts. These men and women assumed great risk in service to all humanity. On behalf of a grateful Nation, I once again recognize their sacrifices and those of their loved ones. Their service will never be forgotten. "Our Nation also owes its appreciation to Admiral Harold Gehman, Jr. (retired) as well as the other 12 members of the Columbia Accident Investigation Board. As Board Chair, Admiral Gehman and his team have worked tirelessly over the past seven months conducting an exhaustive review of the circumstances surrounding this accident. The next steps for NASA under Sean O'Keefe's leadership must be determined after a thorough review of the entire report, including its recommendations. "Our journey into space will go on. The work of the crew of the Columbia and the heroic explorers who traveled before them will continue."

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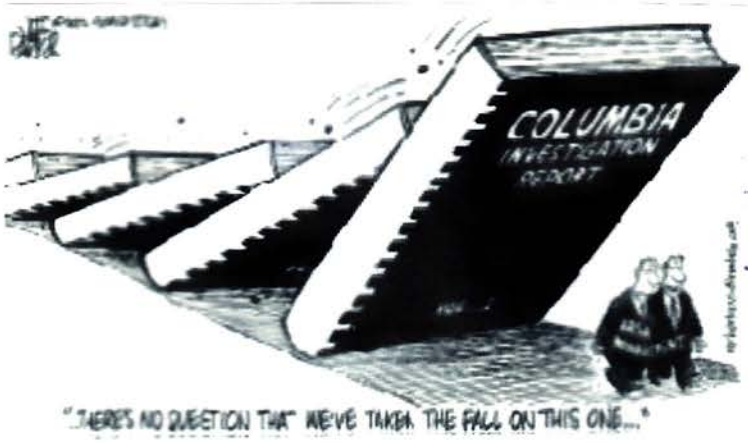

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TASK GROUP RELEASE : 26 AUGUSTUS 2003.

RETURN TO FLIGHT TASK GROUP STATEMENT.

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"We are grateful to the members of the Columbia Accident Investigation Board for their hard work and diligence in service to the nation and its space program over the past seven months. With the release of their final report, the Board has provided the answers to the questions of "what happened?" and "why?" Moreover, looking to the future, the board has provided important recommendations for developing a plan to get -- and keep -- the Space Shuttle flying again safely. "The Return to Flight Task Group is committed to doing its part to help ensure the Shuttle returns safely to space by making a careful, thorough, and independent assessment of NASA's return to flight plans. "Over the coming days and months we will carefully study the board's report and findings, review, digest and assess NASA's plans for implementing the board's recommendations, and provide the NASA Administrator -- and the public -- with our assessments as they pertain to the safety and operational readiness of the STS-114 Space Shuttle mission."

Richard O. Covey
Co-chairman, Return to Flight Task Group
Aug. 26, 2003

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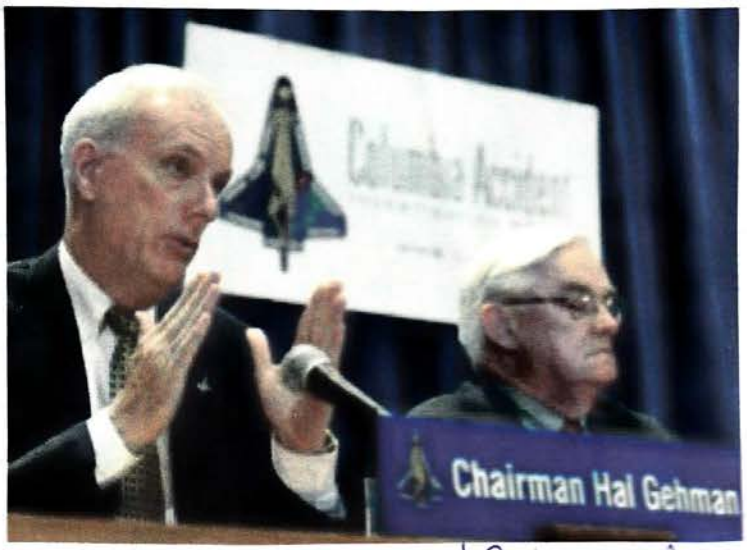
BUNKER BUSTER NASA is braced for the release this week of the Columbia Accident Investigation Board's final report, a massive dissection of the entrenched agency "culture" that board members believe contributed to the Feb. 1 shuttle reentry disaster. Despite early complaints by Capitol Hill Democrats that the board wasn't sufficiently independent, agency officials up to and including Administrator Sean O'Keefe don't expect to get an early look at the report and its accompanying CD-ROM before it is released on the board's web site at 10 a.m. EDT Tuesday. The board has issued five interim technical recommendations, to give NASA a head start on meeting them for an early return to flight operations. Agency engineers report progress on those technical fixes, although they remain stymied by the board's call for an in-orbit capability to fix damaged reinforced carbon-carbon thermal protection system elements like the leading-edge panel implicated in Columbia's loss. On the cultural/management side, the accident board has telegraphed a highly critical take on sociological factors that contributed to the accident, and O'Keefe has repeatedly urged NASA employees to expect the worst in the final report.

AWST: 25-08-2003



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SPACE.COM : 26 AUGUSTUS 2003.

NASA'S CHARACTER TO BE TESTED IN COMING MONTHS.

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CAPE CANAVERAL - Its management culture indicted by the Columbia Accident Investigation Board (CAIB), NASA leaders now will learn something about their character. "This is one of the seminal moments in our history," NASA Administrator Sean O'Keefe told agency employees on Tuesday following the release of the CAIB's final report into the Feb. 1 shuttle tragedy. Seven astronauts were lost because a chunk of insulating foam shed from Columbia's external tank during launch and struck the spaceplane's left wing, punching a hole into the leading edge. During re-entry the opening allowed hot gas inside, triggering the break up. That technical explanation, however, was only part of the story. The CAIB also found that deficiencies in communication, missed signals from failing hardware, complacency bred by success and other factors of a sociological and psychological nature -- NASA's culture -- was as much to blame as a two-pound block of insulation. "The NASA organizational culture had as much to do with this accident as the foam," the 248-page report said. Several specific changes in NASA's organizational structure were defined, including creation of an independent technical engineering and evaluation group to ensure the orbiter is as safe to fly as possible. Reaction from around the nation varied, but was generally supportive of the CAIB's findings and recommendations. However there was a lack of quick promises of the additional funding it will inevitably take to implement all of the CAIB's requirements and observations. "The next steps for NASA under Sean O'Keefe's leadership must be determined after a thorough review of the entire report, including its recommendations," President George Bush said in a statement released by the White House. "Our journey into space will go on. The work of the crew of the Columbia and the heroic explorers who traveled before them will continue." U.S. Rep. Dave Weldon (R-Fla.), whose district includes the Kennedy Space Center, sits on the House Appropriations Committee and said it will take the cooperation of the White House, Congress and the aerospace industry to emerge from the Columbia tragedy with a better space program. "The onus is now on NASA to take these recommendations to heart," Weldon said. "It is, however, the duty of Congress to provide oversight and financial assistance where needed to aid NASA in being able to operate the human spaceflight enterprise in a safer and more robust fashion." Support for the report's findings came from the National Space Society (NSS), a Washington-based space advocacy group that also sought Tuesday to remind the inside-the-beltway crowd of the nation's capitol that it will take more money from the White House and Congress to fix NASA, get flying again and move on with new programs. "We are a nation of explorers, and a bold new vision of the exploration of space will be welcomed by the American public and our international partners," NSS director Brian Chase said in a statement. "No society has ever gone wrong opening up the frontier, and we shouldn't stop now." All that said, the CAIB would just like to make sure NASA doesn't file their report next to the Apollo 1 and Challenger reports and forget about it after a couple of years. That would be a travesty to the memory of the fallen astronauts, CAIB officials said. "The loss of their lives had better make a difference or this board wasted its time," said CAIB chairman Harold Gehman, a retired Navy Admiral. Not to worry, NASA's top manager said. In his remarks to agency employees, broadcast nationwide on NASA TV, O'Keefe promised full cooperation and that, for the sake of the Columbia astronaut's survivors, shuttles will fly again. "We must be as resolute and as courageous in our efforts as the families have been in working through this horrible tragedy," O'Keefe said. "How we respond to the days, weeks and months ahead will matter as much as what we decide to do, and whether it will be a lasting change."O'Keefe recalled the words of legendary flight director Gene Kranz, who when speaking of the 1967 Apollo 1 fire said: "We were the cause. We were not ready. We did not do our job. We were rolling the dice, hoping things would come together by launch day, when in our hearts we knew it would take a miracle. We were pushing the schedule and betting that the Cape would slip before we did." O'Keefe spoke of how Kranz lectured his flight controllers, tasking them to go back to their offices and write the words "tough" and "competent" on their blackboards, and to never erase those words. "I would suggest that we indeed also adopt the principles of tough and competent, and each day, when we enter, and we do what we do throughout this agency, every single one of us, we ought to be reminded of the price paid by Husband, McCool, Anderson, Clark, Chawla, Brown and Ramon. These words are the price of admission to the ranks of NASA, and we should adopt it that way," O'Keefe said. "Let's go to work."

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CNN : 26 AUGUSTUS 2003.

COLUMBIA REPORT FAUTLS NASA ORGANIZATIONAL CULTURE.

WASHINGTON - The Columbia disaster "had as much to do with" NASA's organizational culture as it did with a piece of foam striking the space shuttle's wing, according to a final report released Tuesday by a NASA investigation board. The Columbia Accident Investigation Board's final report says the disaster involved a piece of foam that broke off the shuttle's external tank on takeoff. The foam struck the underside of the orbiter's wing, creating a breach in the heat-reflecting tiles that allowed hot atmospheric gases to seep in on re-entry to Earth. All seven astronauts aboard Columbia were killed when the shuttle broke up over Texas on February 1. "In Chapter 7, the Board presents its view that NASA's organizational culture had as much to do with this accident as foam did," the report's executive summary said. It went on to say, "the report notes that only significant structural changes to NASA's organizational culture will enable it to succeed." The 248-page report says the NASA "organization does not provide effective checks and balances, does not have an independent safety program, and has not demonstrated the characteristics of a learning organization." It recommends a strong safety program be implemented with Congress and the White House to be accountable. The report also indicates that NASA risks future accidents if its recommendations are not carried out. "The Board has no confidence that the Space Shuttle can be safely operated for more than a few years based solely on renewed post-accident vigilance." NASA should also begin developing an orbital space plane -- with safety a high priority -- that would eventually replace the shuttle, the report said. On Monday, NASA Administrator Sean O'Keefe told CNN's Miles O'Brien that the agency missed signs of trouble that led to the accident. "This was a case where we missed it. Just flat missed it," he said of the significance of the foam strike. Launch technicians did see the incident, 81 seconds after takeoff, but in a series of memos engineers determined that whatever damage did occur would not have a great impact on the orbiter. Tests performed later by the investigation board to replicate the foam strike left a huge hole in a replica of the shuttle's wing. As for when space flight will resume, O'Keefe said no date has been set yet. The space shuttle Atlantis is the next orbiter due to fly. "We will fly when we are fit to fly," he said. "It could be as early as spring, if we see the opportunities work out right." O'Keefe, who was appointed by President Bush in 2001, praised the work of the investigation board. "I think Admiral Gehman and his colleagues have done a tremendous public service. They have done a more thorough review and investigation than I have ever heard of anywhere," he said. "And when this report comes out, I think that will be pretty evident for everyone to see, the diligence they put to this."

81042

NASA NEWS RELEASE : 26 AUGUSTUS 2003.

NASA ADMINISTRATOR ACCEPTS COLUMBIA ACCIDENT REPORT.

81043

This morning, NASA Administrator Sean O'Keefe received the report of the Columbia Accident Investigation Board (CAIB) from the chairman, retired U.S. Navy Admiral Harold Gehman. The following is a statement from the NASA Administrator regarding the CAIB report. "On the day of the Columbia tragedy, NASA committed to the families of STS-107's crew that we would find the problems that caused this horrible accident, fix them, and return to the exploration objectives their loved ones dedicated their lives to. Today, we have completed the first phase of that important commitment. "This morning, Admiral Hal Gehman presented the findings and recommendations of the Columbia Accident Investigation Board. The members have established what they believe to be the probable cause of the accident and the factors that contributed to the tragic loss of Columbia and her courageous crew. "I want to express NASA's appreciation for the Board's report, which is timely, thorough, and direct. The efforts of all concerned with the investigation will help NASA improve the Space Shuttle program, our management processes, and our capability to safely return to flight. "The findings and recommendations of the Columbia Accident Investigation Board will serve as NASA's blueprint. We have accepted the findings and will comply with the recommendations to the best of our ability. The Board has provided NASA with an important road map, as we determine when we will be 'Fit to Fly' again. "Due to the comprehensive, timely and open public communication displayed by the Board throughout the investigative process, we already have begun to take action on the earlier issued recommendations, and we intend to comply with the full range of recommendations released today. "Our 'Return to Flight' efforts are being led by NASA's Associate Administrator for Space Flight, William Readdy, and our Associate Deputy Administrator for Technical Programs, Dr. Michael Greenfield. They will work closely with the independent Return to Flight Task Group, led by retired U.S. Air Force Lieutenant General and former Apollo commander Thomas P. Stafford and former Space Shuttle commander Richard O. Covey. The 'Stafford-Covey Task Group' will independently assess every action NASA takes, as we return to flight operations. "As an important step to change the culture of the agency, we have created the NASA Engineering Safety Center (NESC) at the agency's Langley Research Center in Hampton, Va., to provide comprehensive examination of all NASA programs and projects. The NESC will provide a central location to coordinate and conduct robust engineering and safety assessment across the entire agency. The NESC will play a key role in ensuring we return to flight safely and sustain a high level of engineering and safety excellence for every NASA program. "The independent Columbia Accident Investigation Board performed an important service for the Nation, for NASA, and for the dedicated families of Columbia's crew. The Board members conducted a thorough and comprehensive review of the mission and the entire Space Shuttle program. The Board's efforts to perform a timely and a complete investigation into the technological, engineering, managerial, and human aspects that contributed to the accident are nothing short of heroic in nature. We are grateful for their dedication."

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BBC : 26 AUGUSTUS 2003.

NASA BOSS PLEDGES CHANGES.

81045

The head of Nasa has pledged to introduce changes to the US space agency following a scathing independent report into the fatal break-up of the Columbia space shuttle. Nasa administrator Sean O'Keefe is due to give his formal response to the report on Wednesday but has already said some of the recommendations are being implemented. They include a new centre overseeing the safety of all Nasa's programmes as well as an independent task force to check steps taken to get the remaining shuttles flying again. Management blunders were as much to blame as technical problems for the destruction of the shuttle, the Columbia Accident Investigations Board (CAIB) said on Tuesday. Columbia disintegrated as it re-entered the Earth's atmosphere on 1 February, 2003, killing its crew of seven astronauts. The final conclusions of the CAIB inquiry reaffirmed the view that a breach of the heat shield caused the break-up. It concluded a piece of foam insulation hitting the shuttle's left wing had blown a hole in the panel. This allowed super hot gases to penetrate, leading to the shuttle's disintegration as it prepared to land. It said Nasa managers missed at least eight opportunities to evaluate possible damage to the orbiter's heat shield, since similar foam strikes had occurred in the past with no adverse effects. The problem was overlooked because of a growing culture within the space agency whereby "little by little, Nasa was accepting more and more risk in order to stay on schedule," said the report. The CAIB concluded that while the current space shuttle was not inherently unsafe, a number of mechanical changes should be made in order to ensure safety in the short term. "The board strongly believes that if these persistent, systemic flaws are not resolved, the scene is set for another accident," the report said. Mr O'Keefe said on Tuesday his agency would follow all the report's recommendations necessary to get the shuttles flying again as soon as possible. "We have accepted the findings and will comply with the recommendations to the best of our ability," he said in a statement. "The board has provided Nasa with an important road map, as we determine when we will be 'Fit to Fly' again." At a press conference later, Mr O'Keefe is expected to give details of an Engineering Safety Centre, which will provide a comprehensive safety examination of all the space agency's programmes. An independent task force is also being set up to oversee every step taken by Nasa to make it safe to fly the remaining shuttles again. Long-term decisions will need to be made too, says the BBC's science correspondent Christine McGourty. The shuttles will ultimately have to be phased out. but a lack of investment in the long-term future means there is no successor in sight, says our correspondent.

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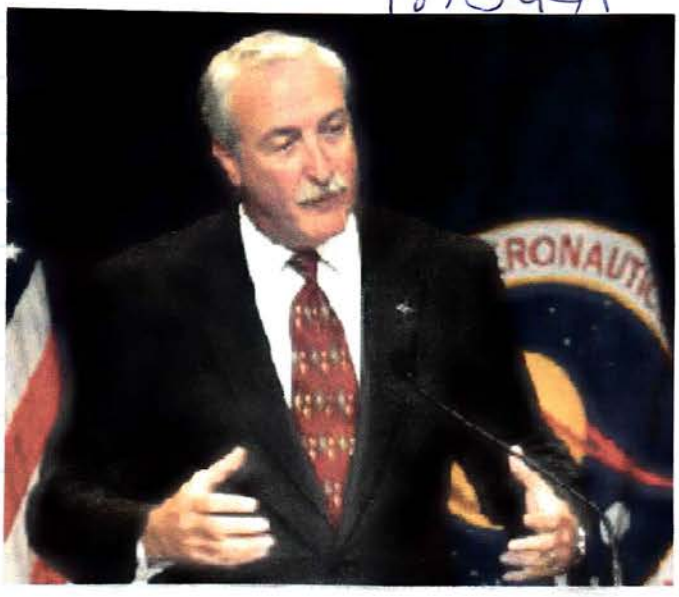

22297

SPACE.COM : 27 AUGUSTUS 2003.

NASA'S O'KEEFE VOWS TO FOLLOW COLUMBIA INVESTIGATION.

WASHINGTON - NASA Administrator Sean O'Keefe vowed Wednesday to pursue all the recommendations the Columbia Accident Investigation Board issued in its 248-page final report. Though O'Keefe had yet to read the lengthy report from cover to cover -- that's on tap, he said, for the long Labor Day weekend ahead -- the Board's hard hitting assessment of the role NASA's organizational culture played in the Feb.1 space shuttle accident hit home. "We get it," O'Keefe said. "[We] clearly got the point." Changing NASA's organizational culture -- defined by the Board as simply "the way we do things here" -- may be the toughest challenge the agency faces as it prepares to return its remaining fleet to flight operations. The report was released Tuesday. O'Keefe acknowledged as much during a press conference at NASA Headquarters. "It's not just about walking around telling everybody to shape up or ship out," he said, adding, "it's going to take sustained leadership." O'Keefe also made clear that he is unlikely to ask anyone else to "ship out" as a result of his or her role in the accident. "It's not about changing boxes or individual faces in those positions," he said. "It's about longer term institutional change and, again, to that point, we get it." Most of the senior NASA personnel directly mentioned by name in the report's assessment of "missed opportunities" during Columbia's 16-day mission have since resigned or been transferred to other jobs in the agency. Notable exceptions include William Readdy, NASA's associate administrator for space flight, and Bryan O'Connor, the agency's associate administrator for safety and mission assurance. O'Keefe defended the fitness of his senior management team. He pointed out that all four NASA field centers with lead roles in human space flight -- Johnson Space Center, Kennedy Space Center, Marshall Space Flight Center, and Stennis Space Center -- have all seen a change of leadership at the top since he took over in January 2002. NASA's preliminary Return to Flight implementation plan is expected to be completed in seven to 10 days. A NASA source told SPACE.com the Return to Flight team is working toward a deadline of Sept. 5 for delivering the plan to the U.S. Congress. O'Keefe gave no clear indication of when NASA expects the shuttle fleet to resume service and pointedly declined to reaffirm the March 2004 target set before the report's release. "When we have made the judgement that we are fit to fly, that's when we will do so," he said.

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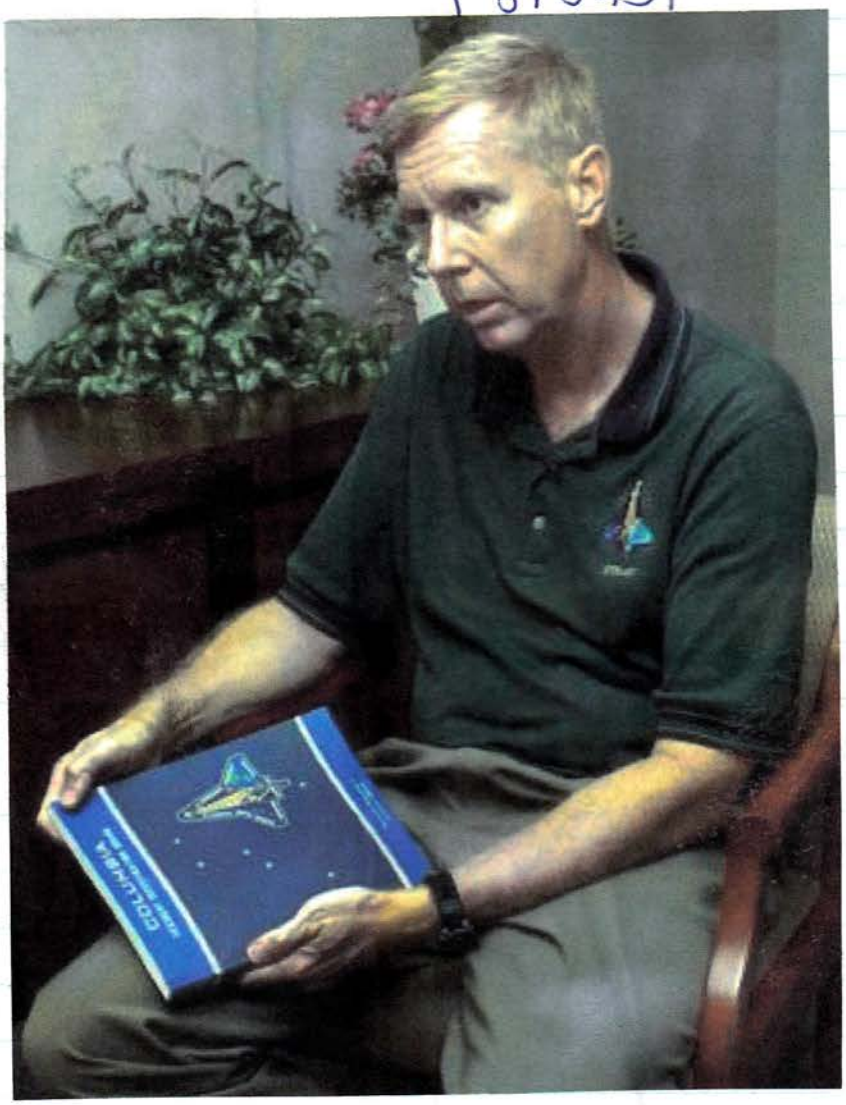

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CNN : 27 AUGUSTUS 2003.

SHUTTLE NOT LIKELY TO FLY BY SPRING, EXPERTS SAY.

Even if NASA adopts only the minimal recommendations from an independent panel to return the space shuttle to service, experts say the fleet will likely remain grounded much longer than spring 2004, when the agency had hoped to resume flights. That optimistic timeline had been offered by numerous NASA managers, who would like to resume shuttle flights to the international space station soon to send crews and components to the unfinished orbiting outpost. But the corrective actions suggested by the Columbia Accident Investigation Board this week to prevent future shuttle disasters will likely put a damper on those plans, according to space experts. "Maybe there is a some possibility to launch by the spring, but I don't think anyone seriously thinks that the launch will be that soon," said Norman Thagard, a former NASA astronaut and five-time shuttle flier. "I think we're going to fly a year from now," echoed Keith Cowling, a former NASA employee and current editor of NASAWatch.com, an independent watchdog Web site. Among dozens of long-term suggestions, which deal in large part with institutional changes to make the NASA bureaucracy more safety conscious, the CAIB report offered eight short-term recommendations before returning to flight, many of which concern engineering issues. For example, the first two advise the agency to begin fixes that prevent foam from shedding from external fuel tanks during launch and strengthen external shuttle wing parts that might be struck by foam debris. "My own gut feeling is they will have to have corrected one or the other problem before they can fly again," Thagard said. One such foam chunk is thought to have struck the leading edge of Columbia during liftoff, creating a puncture that proved fatal as the orbiter reentered the atmosphere 16 days later. Cowling noted that for such fixes, "there's some time involved. It's rather optimistic to get everything done to actually meet the recommendations and expect to fly in anything less than a year." Despite such predictions, the CAIB chairman said he thought there is a chance the shuttle could return to service between six and nine months. "None of the recommendations are particularly difficult and I don't see any reason why they couldn't resume flying in six to nine months from now," retired Adm. Harold Gehman Jr. told CNN's American Morning on Wednesday. Regardless of the timeframe, NASA will probably need loads of money to adopt the reforms, even the basic return-to-flight ones. "They are saying it's not going to be small change. We have to be prepared for the shocking numbers they are going to give us," said Catherine Buell, a former Boeing employee who worked on the international space station project. Getting more federal money may be quite a challenge, considering that the U.S space agency has experienced dwindling budgets and political support in recent years, according to space experts. Buell said that the Bush administration "has never been that supportive of human spaceflight." And some congressional leaders have openly questioned the value of resuming shuttle flights at all, given the costs and risks. "Congress will not help NASA fly sooner. Quite the contrary," Cowling said. After Columbia broke apart with the loss of seven astronauts in February, NASA grounded the orbiter fleet, forcing the United States and its international partners to rely on smaller Russian Soyuz spacecraft to deliver cargo and crews to the space station. NASA would like to return to flight primarily to resume work on the multibillion-dollar outpost. But the ambitious construction schedule, the CAIB cautioned, was a major reason for what put Columbia at risk in the first place. With the White House and Congress pressuring NASA to reduce space station costs and construction delays, the agency felt compelled to adhere to a fixed shuttle flight schedule for station missions, which would affect non-station missions as well, the report said.

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FLORIDA TODAY : 28 AUGUSTUS 2003.

FLORIDA LAUNCH SITE WORKERS ENCOURAGED TO SPEAK UP FOR SAFETY.

81051

CAPE CANAVERAL - Kennedy Space Center workers are encouraged to speak up about safety concerns and can do so without fear of retribution, the shuttle launch and landing site's top boss said Wednesday. "If you ever see me criticize someone for expressing their open and honest feeling at the Kennedy Space Center, I suggest you call my hand on it and I will resign," KSC Director Jim Kennedy told reporters. The declaration was part of Kennedy's first public reaction to the Columbia Accident Investigation Board's final report, which blamed in equal measure the failure of hardware and NASA's management culture for the Feb. 1 tragedy. That flawed culture allowed, according to the CAIB report, technical problems to go undetected, reliance on past success to cloud judgement and the creation of a decision-making process that circumvented the established rules. Disruptions in communication between engineers and managers at all levels also were cited throughout the report -- prompting Kennedy's pronouncement. And although it's still difficult to specifically define and measure, and managers are not yet completely sure how it will be corrected, the culture will be dealt with, Kennedy said. "We get it. We understand that things have to change. While it is inherently against human nature to make change, we understand that for the safety of flight, for the future astronauts who will fly on the shuttle, we must do business differently," Kennedy said. In the meantime, the KSC workforce already is moving forward with implementing the findings and recommendations of the CAIB report that directly apply to the Florida base. To that end, Kennedy offered these updates: Ground equipment and launch processing software is being modified to handle the addition of heaters on the shuttle's external tank. The heaters will replace a wedge of foam that was the source of the debris that hit Columbia's wing. Similar modifications are in work to handle the addition of rocketcams on the shuttle so engineers can better see any foam shedding from the tank during launch. At least one camera is to fly on the tank, while others may be attached to the orbiter. The number of available tracking cameras that follow the shuttle during launch should be doubled from five to 10, a number that should ensure there are at least three quality views of the vehicle from liftoff through the first two minutes and 45 seconds of the mission. Details still need to be worked out. The definition of Foreign Object Debris is being standardized so that no matter where a shuttle is at KSC, all workers are following the same guidelines for preventing "litter" from getting into the vehicle or damaging it. The CAIB found that hasn't been the case before. The reinforced carbon carbon (RCC) panels for shuttle Atlantis have been removed and returned to their original factory for non-destructive testing. The panels make up the shuttle wing's leading edge and protect the vehicle from the hottest re-entry temperatures. Engineers are looking at a technology called flash thermography to inspect the RCC panels without removing them. The procedure involves sending heat pulses into a panel and tracking temperature changes through the composite material using a heat-sensitive imaging system. Necessary changes to KSC's contribution to NASA's Return to Flight Implementation Plan following the release of the CAIB report on Tuesday were proposed within hours and will be incorporated into the final document, which is scheduled to be complete by Sept. 5. All of the ground support equipment needed for shuttle processing is being inspected and tested to make sure the hardware still meets the requirements of its original certification -- an effort not specifically requested by the CAIB. Although he hadn't read all 248 pages of the report yet, Kennedy said he did have a clear understanding of KSC's role in meeting the CAIB's requirements and was optimistic his team would be ready to fly when the agency was. Moreover, the extra work that is likely to be levied on the Florida spaceport will mean there won't be any jobs lost, and could mean new workers will have to be hired, Kennedy said. "We are taking a look at the requirements to do work that was not previously on our plates. And I will tell you that there is an upswing in the requirements, both for our (United Space Alliance) contractor and for NASA oversight/insight activity at the Kennedy Space Center," he said. "The work ahead of us is clear, it is significant and will not result in a loss of jobs."

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'Nasa schuldig aan ongeluk'

WASHINGTON • De leiding van de Amerikaanse ruimtevaartorganisatie Nasa is net zo schuldig aan het ongeluk met het ruimteveer Columbia begin dit jaar als de technische gebreken. Dat is een van de belangrijkste conclusies uit het officiële onderzoek naar de ramp waarvan de resultaten gisteren werden gepubliceerd.

Uit het rapport blijkt dat een afgebroken stuk isolatiemateriaal de beschermende huid van de linkervleugel van de shuttle tijdens de lancering op 16 januari heeft doorboord. Hierdoor ontstond oververhitting door zeer hete gassen tijdens de terugkeer in de dampkring van de aarde op 1 februari. Het ruimteveer brak in stukken. Alle zeven astronauten aan boord kwamen om. De onderzoekscommissie concludeert dat het ongeluk nooit had kunnen gebeuren als de leiding van Nasa eerder aan de bel had getrokken. „Wij zijn ervan overtuigd dat slecht management van het project net zo heeft bijgedragen aan het ongeluk als het stuk isolatieschuim dat de vleugel raakte." Het rapport stelt verder dat beperkte mankracht, een te beperkt budget en verouderd materiaal ook tot het ongeval hebben geleid.

Volgens de commissie negeerden de leiders van de missie klachten van Nasa-ingenieurs over stukken isolatiemateriaal die op eerdere vluchten waren losgeraakt. Ook zou er bij de lancering van de Columbia te weinig cameratoezicht zijn geweest. Kort na de lancering vroegen technici om de shuttle met een satelliet op mogelijke schade te onderzoeken. Het management negeerde drie expliciete verzoeken daartoe, omdat in het verleden ook stukken isolatieschuim waren afgebroken zonder dat dat gevolgen had gehad. Daardoor zagen de leidinggevenden dit ten onrechte niet als een veiligheidsrisico, aldus het rapport.

De commissie vindt dat Nasa een reddingsmissie op touw had moeten zetten voor de astronauten. Daarvoor was het ruimteveer Atlantis beschikbaar. De lancering van deze shuttle moest dan wel binnen zeven dagen na die van de Columbia plaatsvinden om het ruimteveer in zijn baan om de aarde op tijd te bereiken. Omdat Nasa de ernst van de situatie niet inzag, is deze reddingspoging nooit ondernomen.

De conclusie van het rapport is dat Nasa zich niet aan haar eigen veiligheidsprocedures over losgekomen stukken isolatieschuim hield. Ook mist de organisatie een onafhankelijke veiligheidsprocedure. De commissie raadt daarom het Congres aan een permanent en onafhankelijk veiligheidsteam aan te stellen dat op alle toekomstige missies moet toezien. Ook doet de commissie een aantal technische aanbevelingen om rampen in de toekomst te voorkomen.

De commissie vindt het belangrijk het ruimtevaartprogramma zo snel mogelijk te hervatten, omdat dat een centraal onderdeel is van de Amerikaanse ambities in de ruimte. Nasa heeft gegarandeerd dat alle aanbevelingen van de commissie worden uitgevoerd.

27-08-2003

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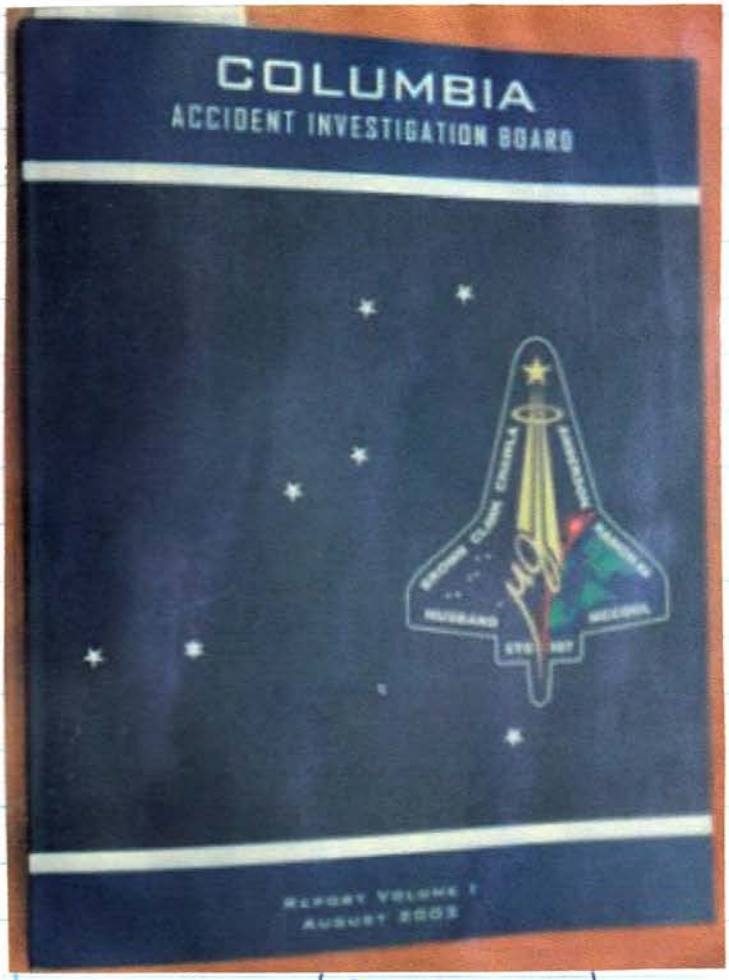

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FLORIDA TODAY : 31 AUGUSTUS 2003.

ASTRONAUTS HAVE PLACE ON MANAGEMENT TEAM, CHIEF SAYS.

$1055

WASHINGTON - NASA should put astronauts on the post-Columbia management team that will be responsible for shepherding future shuttle crews safely through flights, a veteran space flier told Florida Today. What's more, the agency should have a member of each shuttle crew -- or an Astronaut Office representative -- follow orbiters through post-flight inspections and maintenance work to keep tabs on any safety issues that crop up between missions. Doing so would give astronauts a stronger role in overseeing the way NASA handles flight safety issues and trends such as the persistent problems with foam debris and booster O-ring seals that ultimately doomed shuttles Columbia and Challenger. "When we, the flight crew, return from flight, I think we sort of drop out of the orbiter-turnaround cycle because we get pulled off to do other things," former astronaut Winston Scott said in an interview. "We're doing reports. We're doing debriefings. We're doing public appearances. And we don't follow the orbiter anymore," said Scott, now the executive director of the Florida Space Authority, the state's space agency. "Well, somebody -- an astronaut -- needs to be part of the team that picks up an orbiter after flight and follows it through" post-flight inspections and maintenance work. NASA Chief Astronaut Kent Rominger thinks that is a good idea. "It makes a lot of sense," he said. The Astronaut Office for years has assigned members to work at KSC. Known as "Cape Crusaders," they keep track of shuttle processing, but chief astronaut Kent Rominger is considering assigning individual astronauts to follow post-flight work on each orbiter. "We can and need to do a better job of staying up with work on the vehicles," he said. Comments from both Rominger and Winston Scott, a space veteran and executive director of the Florida Space Authority, come on the heels of a scathing report from the board that investigated the Feb. 1 Columbia accident that destroyed a $2 billion orbiter and killed seven astronauts. Unlike the 1986 Challenger investigation board, which urged NASA to place astronauts into management positions, the Columbia panel made no such recommendations. That role today typically is limited to technical assignments that astronauts are given if they are not training for a shuttle mission. Those assignments range from tracking problems with shuttle propulsion systems -- such as its solid-fueled rocket boosters and liquid-fueled main engines -- to keeping up with issues associated with shuttle brakes, tires and landing gear. "Everybody has a technical assignment when they are not actually training for flight, so they are usually out with the managers and engineers throughout the program," former astronaut Norman Thagard said. "That would be true whether or not we had just had an accident." Now a professor of electrical engineering at Florida State University, Thagard said those technical jobs traditionally have enabled astronauts to stay well informed on flight safety issues. And they also put astronauts in the position to voice concerns when problems arise that could trigger catastrophe. "Usually, you find that in the end, the astronauts agree with the engineers and the managers because everybody has to agree the thing is safe for flight or someone will yell and scream, and the process will stop," Thagard said.

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SPACE.COM : 04 SEPTEMBER 2003.

FATE OF PLUTO MISSION IN SENATE'S HANDS.

In an ongoing battle for funding of a mission to Pluto, the non-profit Planetary Society this week issued a plea to its members to write Congress and request the mission's budget not be trimmed. Time is short, the organization notes. As reported by SPACE.com in July, NASA's New Horizon's mission to Pluto and the Kuiper Belt is in jeopardy after a surprise House vote cut $55 million from NASA's $130 million New Frontiers budget for 2004. The Senate Appropriations Committee is slated to take the matter up Thursday. Alan Stern of the Southwest Research Institute in Boulder, Colo., directs New Horizons for NASA. "If the New Frontiers cut isn't reversed, it'll delay the arrival of New Horizons at Pluto by four to five years, adding flight time, risk and cost, and it will delay the start of the second New Frontiers mission by at least a year," Stern said via e-mail from a conference in California. "It'll be a serious blow to one of NASA's crown jewels -- it's planetary program." Funding for New Horizons began modestly in 2002 and in February its financial future seemed secure. The recently proposed budget cut came as a shock to Stern and others who've fought for the mission for years. An internal mission analysis document obtained by SPACE.com states that the funding cut could jeopardize the Pluto mission entirely, wasting the roughly $140 million already spent in planning and early construction. If fully funded, the craft would launch in 2006 and arrive in 2015

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SPACE TELESCOPE SCIENCE INSTITUTE NEWS RELEASE : 07 SEPTEMBER 2003.

HUBBLE FINDS FARTHESTM FAINTEST SOLAR SYSTEM OBJECTS.

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Astronomers using NASA's Hubble Space Telescope have discovered three of the faintest and smallest objects ever detected beyond Neptune. Each object is a lump of ice and rock -- roughly the size of Philadelphia -- orbiting beyond Neptune and Pluto, where the icy bodies may have dwelled since the formation of the solar system 4.5 billion years ago. They reside in a ring-shaped region called the Kuiper Belt, which houses a swarm of icy rocks that are leftover building blocks, or "planetesimals," from the solar system's creation. The results of the search were announced by a group led by astronomer Gary Bernstein of the University of Pennsylvania at the meeting of the Division of Planetary Sciences in Monterey, Calif. The study's big surprise is that so few Kuiper Belt members were discovered. With Hubble's exquisite resolution, Bernstein and his co-workers expected to find at least 60 Kuiper Belt members as small as 10 miles (15 km) in diameter -- but only three were discovered. "Discovering many fewer Kuiper Belt objects than was predicted makes it difficult to understand how so many comets appear near Earth, since many comets were thought to originate in the Kuiper Belt," Bernstein says. "This is a sign that perhaps the smaller planetesimals have been shattered into dust by colliding with each other over the past few billion years." Bernstein and his colleagues used Hubble to look for planetesimals that are much smaller and fainter than can be seen from ground-based telescopes. Hubble's Advanced Camera for Surveys was pointed at a region in the constellation Virgo over a 15-day period in January and February 2003. A bank of 10 computers on the ground worked for six months searching for faint-moving spots in the Hubble images. The search netted three small objects, named 2003 BF91, 2003 BG91, and 2003 BH91, which range in size from 15-28 miles (25-45 km) across. They are the smallest objects ever found beyond Neptune. At their current locations, these icy bodies are a billion times fainter (29th magnitude) than the dimmest objects visible to the naked eye. But an icy body of this size that escapes the Kuiper Belt to wander near the Sun can become visible from Earth as a comet as the wandering body starts to evaporate and form a surrounding cloud. Astronomers are probing the Kuiper Belt because the region offers a window on the early history of our solar system. The planets formed over 4 billion years ago from a cloud of gas and dust that surrounded the infant Sun.

Microscopic bits of ice and dust stuck together to form lumps that grew from pebbles to boulders to city- or continent-sized planetesimals. The known planets and moons are the result of collisions between planetesimals. In most of the solar system, all of the planetesimals have either been absorbed into planets or ejected into interstellar space, destroying the traces of the early days of the solar system. Around 1950, Gerard Kuiper and Kenneth Edgeworth proposed that in the region beyond Neptune there are no planets capable of ejecting the leftover planetesimals. There should be a zone, the two astronomers said --- now called the Kuiper Belt -- filled with small, icy bodies. Despite many years of searching, the first such object was not found until 1992. Since then, astronomers have discovered nearly 1,000 from ground-based telescopes. Most astronomers now believe that Pluto, discovered in 1930, is in fact a member of the Kuiper Belt. Astronomers now use the Kuiper Belt to learn about the history of the solar system, much as paleontologists use fossils to study early life. Each event that affected the outer solar system -- such as possible gravitational disturbances from passing stars or long-vanished planets -- is frozen into the properties of the Kuiper Belt members that astronomers see today. If the Hubble telescope could search the entire sky, it would find perhaps a half million planetesimals. If collected into a single planet, however, the resulting object would be only a few times larger than Pluto. The new Hubble observations, combined with the latest ground-based Kuiper Belt surveys, reinforce the idea that Pluto itself and its moon Charon are just large Kuiper Belt members. Why the Kuiper Belt planetesimals did not form a larger planet, and why there are fewer small planetesimals than expected, are questions that will be answered with further Kuiper Belt studies. These studies will help astronomers understand how planets may have formed around other stars as well.

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PROGRESS SHUFFLE Russia's Korolev Flight Control Center near Moscow and the two-man International Space Station Expedition 7 crew have been docking and undocking three different robotic Progress resupply spacecraft during the past two weeks as ISS operations continue without the space shuttle. On Aug. 27, Progress 10 undocked from the aft port on the Zvezda Service Module, where it had been since February, after the last of its oxygen supply was pumped into the station. The vehicle's engines have been used for months to help maintain the station's orbit, and the crew used it as a trash dump before the Korolev center commanded it to undock. That cleared the way for launch of Progress 12 from the Baikonur Cosmodrome on Aug. 28. The vehicle, loaded at Baikonur with about a ton of supplies, docked Aug. 30 on the same Zvezda aft port vacated by Progress 10. In addition, Korolev was scheduled to command the undocking of the Progress 11 spacecraft from the station's Russian Pirs airlock port on Sept. 4. This vehicle had been docked to the ISS since the spring and was separated to make room for the planned launch in September of the new ISS Expedition 8 crew that will dock its Soyuz to the Pirs port. The two Progress vehicles separated from the station were commanded into destructive reentries as part of standard procedure.

AWST: 08-09-'03

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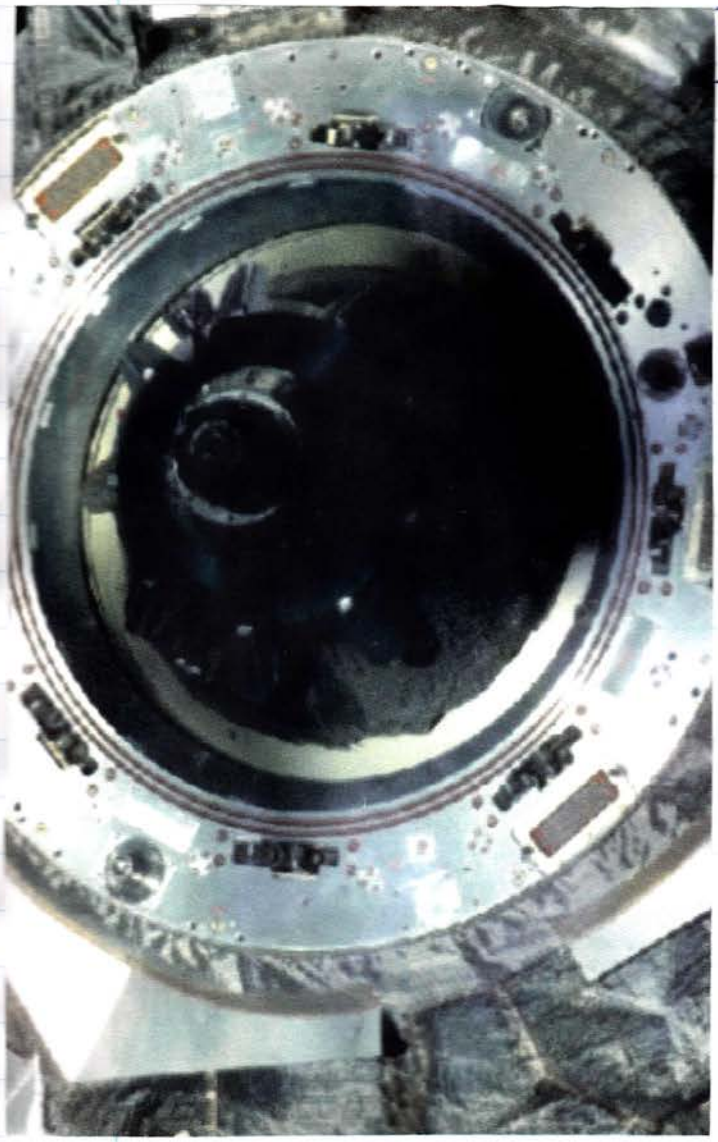

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Cosmonaut ties the knot

ISS Commander Yuri Malenchenko joined the pioneers of space exploration in a unique way on 10 August – by becoming the first cosmonaut to be married whilst in space.

The Russian cosmonaut married his bride – Ekaterina Dmitriev – during a ceremony held over TV communications channels between the orbiting space complex and a room in the Johnson Space Centre in Houston, Texas. The law in the US state of Texas allows for such marriages where the groom is absent from the ceremony as long as there is a valid reason.

However, the path to the unique ceremony was not without some controversy.

On 17 July the Houston Chronicle newspaper reported that a marriage license had been issued that day for a wedding between Malenchenko and Dmitriev (a US citizen of Russian birth) in August which could be held under a 'proxy' arrangement.

The pair had apparently planned an August wedding before Malenchenko learned that he would spend a six-month tour of duty on the ISS. Malenchenko had reportedly written to a lawyer to explain why he could not be present for his planned wedding and this resulted in the issue of the license.

Rather than postpone the wedding the couple reportedly planned to conduct the ceremony on the original date. Malenchenko was reportedly supplied with a ring, tuxedo and bow tie secretly on the Progress M1-10 cargo craft.

Even though American ISS managers were noticeable by their silence about the event the same could not be said for Russian officials who initially forbade the union to take place during the time Malenchenko was in flight.

Speaking to reporters, TsUP official Sergei Gubanov said that because Malenchenko was a serving officer in the Russian Air Force he could not marry a foreigner without official permission - rules dating back to the Soviet era, reports said. He also noted that State assets (the communications facilities) could not be used for such a private purpose. Another official opined that the cosmonaut should not behave "like a movie star."

Cosmonaut Yuri Malenchenko, Expedition Seven mission commander, is pictured with the Plasma Crystal Experiment in the Zvezda Service Module's transfer compartment on the not so romantic Space Station.

By 5 August, however, Malenchenko had reportedly changed his mind and the wedding plans were confirmed.

During the crew's afternoon on Sunday 10 August the ceremony took place during a private communications session between the ISS and Houston.

Science Officer Ed Lu acted as Malenchenko's Best Man.

Russian officials said that whilst the wedding was a new "first" for Russian space history it would also be the last such event. Although they noted that Malenchenko would not face a jail sentence for going ahead with the marriage, despite the objections of the military, future cosmonauts would have it written into their contracts that future nuptials should be completely earthbound!

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Malenchenko cuts Lu's hair in the Zvezda Service Module. Lu holds a vacuum, which a previous crew had fashioned, to garner freshly cut hair that is floating freely.

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Een zwart gat per seconde erbij

Elke seconde ontstaat er ergens in het heelal een nieuw zwart gat. Tenminste, dat beweert Don Lamb van de Universiteit van Chicago. Op een workshop in Santa Fe (New Mexico) presenteerde hij deze week de nieuwste waarnemingen van de HETE 2-satelliet (High-Energy Transient Explorer), die onderzoek doet aan gammaflitsen. Volgens Lamb zijn die enorm veel talrijker dan tot nu toe werd gedacht.

Gammaflitsen zijn korte, krachtige uitbarstingen van energierijke gammastraling. Ze ontstaan wanneer zware, snel roterende sterren aan het eind van hun leven ineenstorten tot een zwart gat. Ze zijn zo krachtig dat ze gemakkelijk tot op vele miljarden lichtjaren afstand 'gezien' kunnen worden.

De afgelopen jaren is ontdekt dat de meeste energie van een gammaflits wordt uitgestraald in twee tegenovergesteld gerichte bundels. Alleen wanneer een van die bundels toevallig in onze richting wijst, zien we een gammaflits. Als je daarvoor corrigeert, kom je uit op ongeveer één flits (en dus één nieuw zwart gat) per tien minuten.

Lamb beweert nu dat het werkelijke aantal nog eens een paar honderd keer zo groot is. Behalve gammaflitsen zijn er de laatste jaren namelijk ook minder energierijke röntgenflitsen ontdekt. Metingen van de HETE 2-satelliet tonen aan dat röntgenflitsen veel eigenschappen gemeen hebben met 'klassieke' gammaflitsen. Dat suggereert dat het in feite om dezelfde soort explosie gaat.

Als dat echt zo is, rekent Lamb voor, moeten de bundels van gammaflitsen veel smaller zijn dan altijd werd gedacht, en is het percentage waargenomen flitsen dus ook veel kleiner. Hij schat het totale aantal flitsen per dag op tien- à honderdduizend. Dat betekent dat er misschien wel elke seconde een nieuw zwart gat ontstaat.

Volgens John Heise van de Space Research Organization Netherlands (SRON) in Utrecht is trouwens niet bekend waardoor röntgenflitsen minder energierijk zijn dan gammaflitsen. Het zou te maken kunnen hebben met de massa van de exploderende ster, of met de rotatiesnelheid. 'Er is wel wat verwarring ontstaan', zegt Heise.

NASA's nieuwe gammaflitskunstmaan Swift, die begin 2004 wordt gelanceerd, is niet ontworpen om röntgenflitsen waar te nemen. Lamb dringt er bij NASA dan ook op aan dat HETE-2 voorlopig nog in bedrijf wordt gehouden.

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Volkskrant: 13-09-2003

SPACE.COM : 17 SEPTEMBER 2003.

NEW THEORY : UNIVERSE BORN IN A BLACK HOLE.

§1068

If black holes and the Big Bang befuddle you, try wrapping your brain around this one: The entire universe may have been created in an explosion inside a black hole."It's a mathematically plausible model which refines the standard model of the Big Bang," said Blake Temple, a mathematician at the University of California, Davis.The standard model holds that the universe began about 13.7 billion years ago. The Big Bang is described not as an explosion so much as a rapid outflow of material from a point of nearly infinite density. It is a theory, one among several attempting to describe the observed expansion of the universe today. It has not been proved. The Big Bang has been compared to black holes before, because the tremendous crush of matter that defines a black hole is much like the unfathomable density that preceded the Big Bang. Both phenomena are termed singularities. In the proposed modification to the standard model, the Big Bang is an actual explosion, Temple explained today in a statement, and it occurs within a black hole in an existing space. The shock wave of the explosion is expanding into an infinite space. Temple also describes the whole scenario as a white hole, the theoretical opposite of a black hole because it tosses matter outward instead of pulling it in. White holes have been talked about before, mostly as mathematical curiosities. There is no evidence these "anti-black holes" exist, whereas scientists have solid evidence for the presence of black holes. Eventually, Temple says, the universe will emerge from all this as something like an exploded star, called a supernova, but on an enormously large scale. He said the new theory satisfies Einstein's equations in the General Theory of Relativity, which gave rise to the Big Bang theory.Temple can't say where the matter we see today originally came from. What existed before the Big Bang? This, in fact, is a thorn in the side of all cosmologists, and it may never be answered because we can't see time and space as it existed prior to time as we know it. But Temple and colleague Joel Smoller, from the University of Michigan, wrote recently in the Proceedings of the National Academy of Sciences: "It is natural to wonder if there is a connection between the mass that disappears into black hole singularities and the mass that emerges from white hole singularities." And it remains to be seen, or more likely not, whether any of this is true.

22306

OP WEG NAAR EEUWIGE DUISTERNIS

DDL: 16-09-2003

Niets dan leegte, koude en duisternis. Zo ziet de grimmige toekomst van ons universum eruit. Over miljarden jaren zullen alle sterren aan de nachtelijke hemel zijn gedoofd en gaat het licht voorgoed uit in het heelal. Ook de zon houdt 'binnenkort' op met schijnen.

Dat het heelal op zijn retour is, blijkt uit onderzoek van Engelse en Amerikaanse astronomen. Volgens Alan Heavens, Ben Panter en Raul Jimenez worden er steeds minder nieuwe sterren geboren. Te weinig om alle oude, opgebrande sterren te vervangen en dus komt ooit het moment dat de laatste ster in het heelal zal uitdoven.

De sterrenkundigen publiceerden hun bevindingen in de *Monthly Notices of the Royal Astronomical Society* van 21 augustus. Zij onderzochten veertigduizend sterrenstelsels, kosmische 'eilanden' van meer dan honderd miljard sterren waarvan ons eigen melkwegstelsel er een is. Sterrenstelsels schijnen met het gezamenlijke licht van alle sterren die er deel van uitmaken. De kleur van dit licht zegt iets over het geboortecijfer van nieuwe sterren in zo'n stelsel. Blauw licht duidt op hete, zeer lichtsterke sterren die snel opbranden en dus nog niet zo lang geleden zijn ontstaan. In de loop van de tijd verdwijnen zij als eerste van het kosmische toneel, zodat het roodachtige licht van lichtzwakkere, langer levende sterren de overhand krijgt.
De meeste sterrenstelsels blijken een roodachtige tint te hebben, een teken dat de stervorming over zijn hoogtepunt heen is. De neergang zette zes miljard jaar geleden in, rond dezelfde tijd dat ook onze zon werd gevormd.

Voorlopig zijn er nog sterren genoeg, zo blijkt uit schattingen door astronomen van de Australian National University. Er zijn 70 sextiljoen sterren, ofwel een 7 gevolgd door 22 nullen. Dat is tien keer zoveel als het aantal zandkorrels op alle aardse stranden en woestijnen! En dan gaat het alleen nog maar over het zichtbare deel van het heelal. Sterrenstelsels op de allergrootste afstanden blijven zelfs met de krachtigste telescopen onzichtbaar. Hun licht heeft ons nog niet kunnen bereiken, want daarvoor is sinds het ontstaan van het heelal - 13,7 miljard jaar geleden - simpelweg te weinig tijd verstreken. Hoeveel sterren de kosmos werkelijk telt, weet niemand. Nog steeds worden er nieuwe sterren geboren uit kosmische wolken van gas en stof, terwijl oude, opgebrande exemplaren uitdoven. Sterren zoals de zon schijnen dankzij waterstof. In haar binnenste smelt de zon kernen van waterstofatomen aaneen tot helium. Dat gebeurt nu al 4,5 miljard jaar en zolang de waterstofvoorraad strekt, is er weinig aan de hand. Maar over 5 miljard jaar raakt de brandstof op en is het einde nabij. De kern van de zon begint te krimpen, waardoor de temperatuur oploopt. Al die extra hitte zorgt ervoor dat de buitenkant van de zon opzwelt tot gigantische afmetingen, waarbij de binnenste planeten Mercurius en Venus en wellicht ook de aarde volledig worden verzwolgen.
Maar ook als de aarde de dans net ontspringt, is onze planeet niet veel beter af. De opgezwollen zon zal meer dan de helft van de hemel bedekken en nu haar oppervlak zo dichtbij is, sterft alles de vuurdood. De oceanen koken, de atmosfeer verdampt en de aarde verschroeit tot een kale steenklomp. De mensheid overleeft dit inferno alleen als zij elders in het heelal een veilig toevluchtsoord heeft gevonden. Uiteindelijk blaast de stervende zon haar buitenste lagen de ruimte in. Alleen de uitgebrande kern blijft over en dooft helemaal uit. Alles wat dan nog van de aarde rest, wordt voor eeuwig diepgevroren.

De een zijn dood is de ander zijn brood, ook in de kosmos. Stervende sterren die hun buitenste gaslagen afwerpen, leveren daarmee het bouwmateriaal voor weer een nieuwe generatie sterren. De kosmische kringloop van geboorte en dood is al miljarden jaren actief, maar de recycling werkt niet perfect. Telkens als een ster uitdooft, blijft de uitgebrande kern achter. Astronomen hebben voor deze sintels bizarre namen bedacht, zoals witte dwergen, neutronensterren en zwarte gaten. Steeds meer materie raakt erin opgesloten, totdat er geen bouwstof meer voor nieuwe sterren overblijft. Dan is het slechts een kwestie van tijd voordat de laatste ster is opgebrand.
Volgens de Amerikaanse wetenschappers Fred Adams en Greg Laughlin duurt het nog honderd biljoen jaar (een 1 met 14 nullen) voordat het licht definitief uitgaat in het heelal. In hun boek *The Five Ages of the Universe* uit 1999 beschrijven zij hoe de (verre) toekomst van het heelal eruit ziet. Uiteindelijk bevatten ons melkwegstelsel en de andere sterrenstelsels alleen nog maar sintels zoals witte dwergen, neutronensterren en zwarte gaten, ronddolend door een ijskoude en pikzwarte leegte. Die leegte wordt gestaag groter. Het heelal dijt in een steeds rapper tempo uit, want de sterrenstelsels verwijderen zich van elkaar met een snelheid die alsmaar groeit.

Hoe nu verder? Met zeeën van tijd voor de boeg wordt zelfs het meest onwaarschijnlijke werkelijkheid. Volgens sommige natuurkundige theorieën zijn de fundamentele bouwstenen van de materie zoals het proton op de (zeer) lange termijn niet stabiel. Na 10 biljoen biljoen biljoen jaar (een 1 met 37 nullen) begint het protonverval een rol te spelen en verkruimelen de overgebleven witte dwergen en neutronensterren als oud brood tot niet veel meer dan straling. Alleen zwarte gaten bevolken nu nog het heelal, maar het eeuwige leven is voor niets en niemand weggelegd. Er treedt een soort verdampingsproces op, waardoor ook deze objecten opgaan in straling. Niets, behalve wat zwakke straling, blijft er over en alles sterft uiteindelijk een stille, koude dood. Inmiddels drukken we de leeftijd van het heelal uit in een getal met honderd cijfers...
Een droefgeestig vooruitzicht. Is er nog een speciale rol voor de mens in de kosmos weggelegd als alles oplost in de eeuwigheid van het Grote Niets? „Hoe meer we het heelal begrijpen, hoe zinlozer het lijkt", zo verzucht de Amerikaanse natuurkundige Steven Weinberg in zijn boek *The First Three Minutes*. Maar zingevingsvragen zijn allang uit de 'harde' wetenschap verbannen. Daarvoor moet je bij priesters en filosofen zijn.

EEN STER DIE NEDERIG MAAKT

Door Ron Buitenhuis

Meer dan indrukwekkend. Andere woorden zijn er niet te vinden voor de filmbeelden van de zon, die vanaf 6 oktober in het Haagse Omniversum te zien zijn. De ster die al het leven op deze aarde mogelijk maakt, is in samenwerking met Nasa en ESA 28 dagen vanuit de satelliet SoHo gefilmd. De close up-beelden van de Imax-camera's geven je als kijker een nederig gevoel. Wat is onze aarde kwetsbaar, laat staan de mens. De kracht van de zon is zo overweldigend, dat het elk voorstellingsvermogen te boven gaat. Klein voorbeeldje: elke seconde komt uit de zon evenveel energie vrij, als wij mensen op aarde in een miljoen jaar verbruiken.

De beelden zijn in 2001 gemaakt tijdens de zogenaamde *Solarmax*, meteen ook de naam van de film. Net als de aarde heeft de zon een magnetische noord- en zuidpool. Elke elf jaar wisselen deze polen van plaats. In deze periode van extreem geweld produceert de zon meer energie dan ooit (zonnemaximum). In tijden van een zonneminimum daalt de temperatuur op aarde. Dat moet het geval zijn geweest in de tijd van Pieter Breughel (1525-1569), want op tal van diens schilderijen zijn rivieren te zien die normaliter nooit dichtvriezen.

De ruimte-opnames van de zon zijn in de film gecombineerd met zonneobservaties uit het verleden. Het verhaal begint in de Iers-Keltische *grot van de zon* (Uaimh na Gréine), de oudste door de mens gebouwde ruimte op aarde waar op de kortste dag van het jaar de zonnestralen precies door een dakopening naar binnen schijnen. Vervolgens gaat het via de zonnegoden van de Inca's en het Verre Oosten, Aristoteles, Copernicus, Newton, de vikingen op Groenland en het mysterieuze noorderlicht, naar de Solarmax van 2001. Een reis door tijd en ruimte die veel zonneweetjes oplevert:

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- De zon staat 150 miljoen kilometer van de aarde.
- De diameter van de zon is 109 keer die van de aarde, dat geeft een inhoud die 1,3 miljoen keer groter is.
- De temperatuur in de kern van de zon is 15 miljoen graden en de druk (233 miljard keer groter dan op aarde) zijn zo intens dat er een nucleaire reactie plaatsvindt.
- De energie uit de kern van de zon doet er honderdduizenden jaren over om de oppervlakte van de zon te bereiken.
- De corona is het buitenste deel van de atmosfeer van de zon en heeft een temperatuur van één miljoen graden. De corona stroomt weg als een zonnewind met een snelheid van 450 kilometer per seconde.
- De zon draait bij zijn evenaar in 25 dagen om zijn as.
- Van alle massa in ons zonnestelsel komt 99,8 procent voor rekening van de zon, alle planeten en manen leggen samen slechts 0,2 procent in de schaal.
- Aan het einde van haar leven, zo over 5 miljard jaar, gaat de zon helium omzetten in zwaardere elementen en zal langzaam uitdijen. Uiteindelijk wordt de zon zo groot dat ze de aarde opslokt.

Solarmax in het Omniversum draait vanaf 6 oktober dagelijks om 12.00 uur en is op donderdag en vrijdag tevens om 18.00 uur te zien. Op www.solarmovie.com is achtergrondinformatie te vinden.

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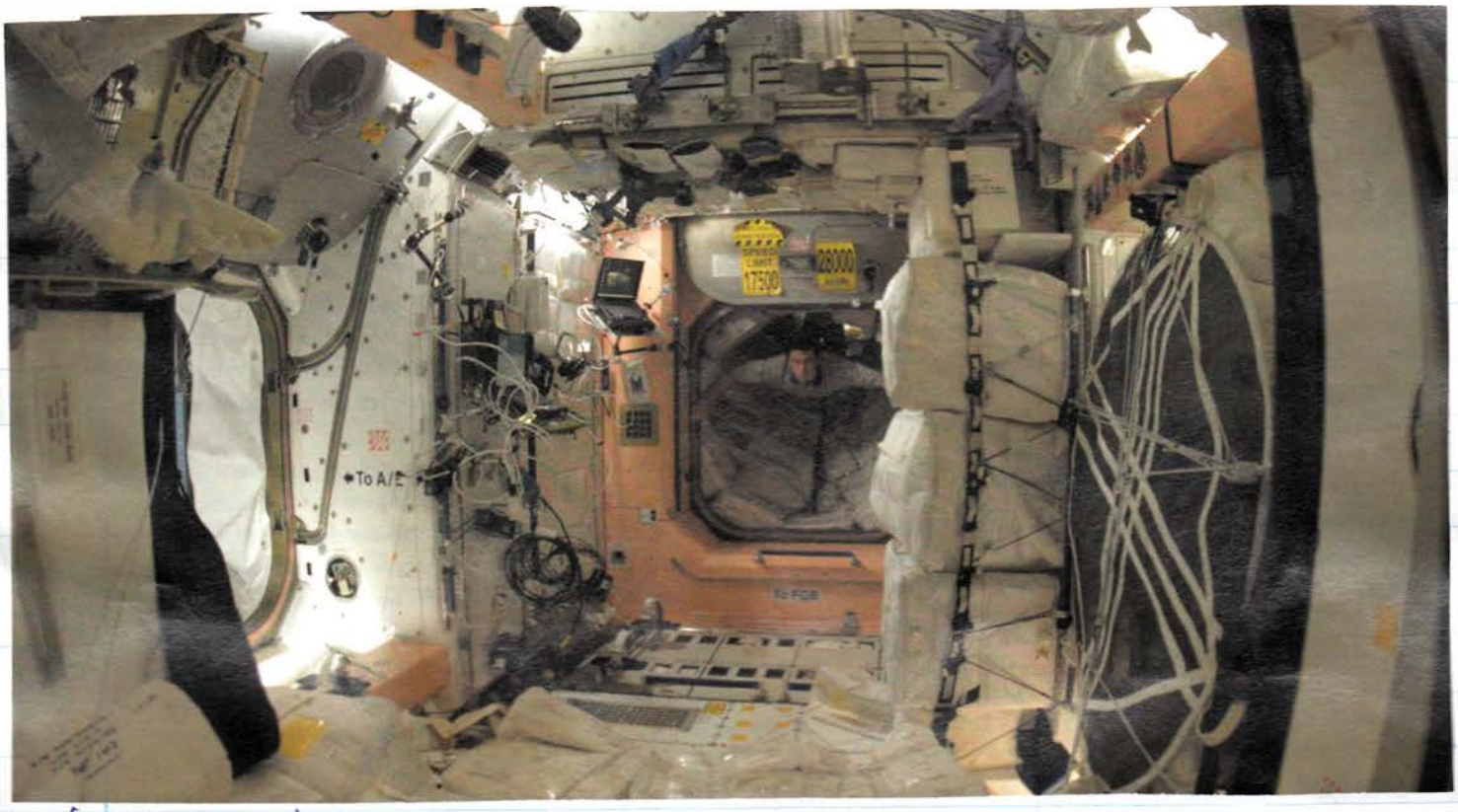
Malenchenko floats into the Unity node on the Space Station.



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NASA AND NORTHROP GRUMMAN NEWS RELEASES : 10 SEPTEMBER 2003.

MIRROR FOR JAMES WEBB SPACE TELESCOPE APPROVED.

NASA today announced a major milestone in the development of the James Webb Space Telescope (JWST), the selection of a beryllium-based mirror technology for the telescope's 6.5-meter primary mirror. The JWST prime contractor, Northrop Grumman, Redondo Beach, Calif., recommended to NASA the mirror technology, supplied by Ball Aerospace & Technologies Corporation, Boulder, Colo., be selected for the JWST primary mirror. Northrop Grumman made the recommendation following a detailed process that took advantage of insights from a panel of experts representing the contractor team, NASA and the science community. Two mirror technologies, beryllium and ultra low-expansion glass, were tested, and their implementation plans were thoroughly reviewed during a six- month evaluation. Technical performance, manufacturing schedule, facilities, staffing, and cost were factors taken into consideration. "We selected beryllium because the review panel rated it as the highest-performing, lowest-technical-risk solution," said David Shuckstes, Northrop Grumman Space Technology JWST program manager. "Beryllium also has demonstrated an impressive track record operating at cryogenic temperatures on space-based telescopes. This selection of beryllium positions the program for successful initiation of optic development." Review panel member Matt Mountain, director of the Gemini Observatory in Hawaii and Chile and the JWST Science Working Group's representative, said, "The review process has resulted in a very rigorous and transparent examination of the key issues, encompassing performance, vendor capabilities, schedule and cost risks. I think the selection will ensure the Observatory's primary segments will be capable of great scientific performance at the L2 Lagrange point." Mirror production will begin within the next few months. The mirrors will be incorporated into optical assemblies, mounted onto the telescope structure and then subjected to a series of tests at cryogenic temperatures, individually and as an integrated system. The Observatory design features a 6.5-meter aperture primary mirror, comprised of 18 hexagonal shaped segments. The telescope will be 2.5 times the diameter, yet weigh only one-third as much, as the mirror on the Hubble Space Telescope. JWST will be orders of magnitude more sensitive than ground-based infrared telescopes. After launch in 2011, JWST will peer into the infrared at great distances to see the first stars and galaxies formed in the universe billions of years ago. A flagship mission in NASA's Origins Program, JWST will search for answers to astronomers' fundamental questions about the birth and evolution of galaxies, the size and shape of the universe, and the mysterious life cycle of matter. NASA's Goddard Space Flight Center, Greenbelt, Md., manages the JWST project for NASA Headquarters Office of Space Science, Washington. The project consists of an international team involving NASA, the European Space Agency, Canadian Space Agency, industry and academia. Northrop Grumman is prime contractor leading a team including Ball Aerospace, Eastman Kodak Company, Rochester, N.Y.; and Alliant Techsystems, Magna, Utah. The major beryllium mirror subcontractors to Ball Aerospace are Tinsley Laboratories, Richmond, Calif.; Axsys Technologies, Cullman, Ala.; and Brush Wellman Inc., Elmore, Ohio.

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BALL'S BERYLLIUM **NASA selected a beryllium-based mirror technology proposed by Ball Aerospace to gather and handle infrared light in the James Webb Space Telescope slated for launch in 2011. Acting on the recommendation of telescope prime contractor Northrop Grumman, NASA picked the Ball approach over an ultra-low-expansion glass technique that Kodak proposed, following tests of both technologies. In this photo, a Ball technician adjusts a hexagonal beryllium mirror segment approximately the same size as the 18 such segments that will make up the primary Webb mirror. The Webb telescope will use a 6.5-meter mirror as its primary light gatherer. Mirror production is scheduled to begin within the next year. The technology was developed under the multi-agency Advanced Mirror System Demonstrator program, designed to push the state of the art for a variety of space applications.**

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AWST: 22-09-2003.

SPACE.COM : 11 SEPTEMBER 2003.

MIRROR DECISION FOR JAMES WEBB SPACE TELESCOPE.

81078

A major step in the building of the James Webb Space Telescope (JWST) has been made - the selection of a beryllium-based mirror technology for the telescope's 21.3-feet (6.5-meter) primary mirror. NASA announced on September 10 the selection of beryllium as the material of choice for 18 hexagonal-shaped mirror segments. A competitive material was also considered -- ultra low-expansion glass -- but was not chosen. Lead JWST contractor, Northrop Grumman, made the recommendation relying on advice from a panel of experts representing the contractor team, NASA and the science community. Mirror production will begin within the next few months. The JWST is now scheduled for launch in August 2011. The super-powerful primary mirror will be 2.5 times the diameter of Hubble's mirror yet weigh only one-third as much. JWST will be orders of magnitude more sensitive than ground-based infrared telescopes.

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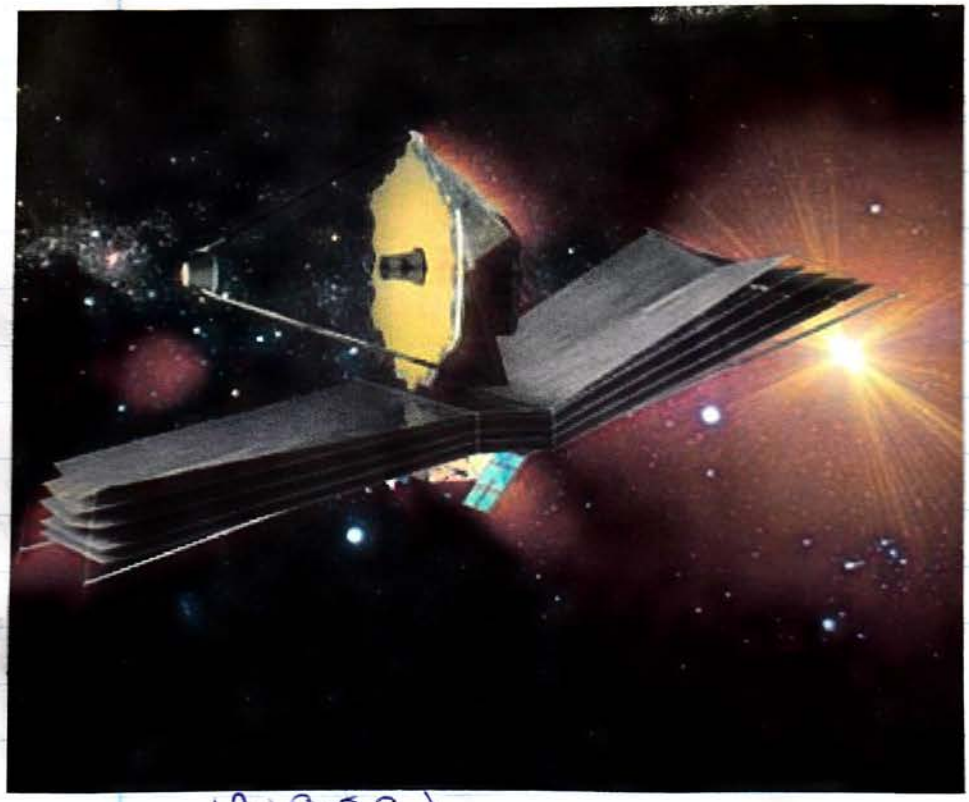

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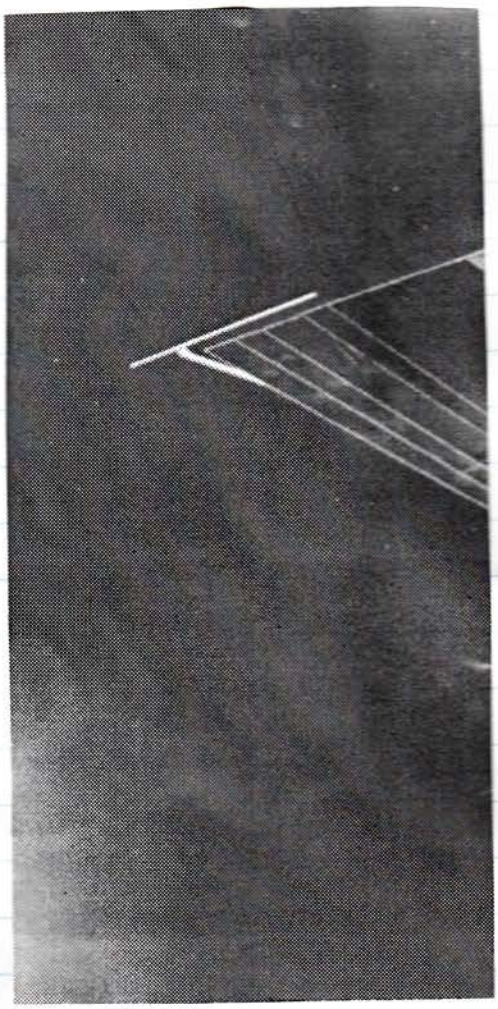

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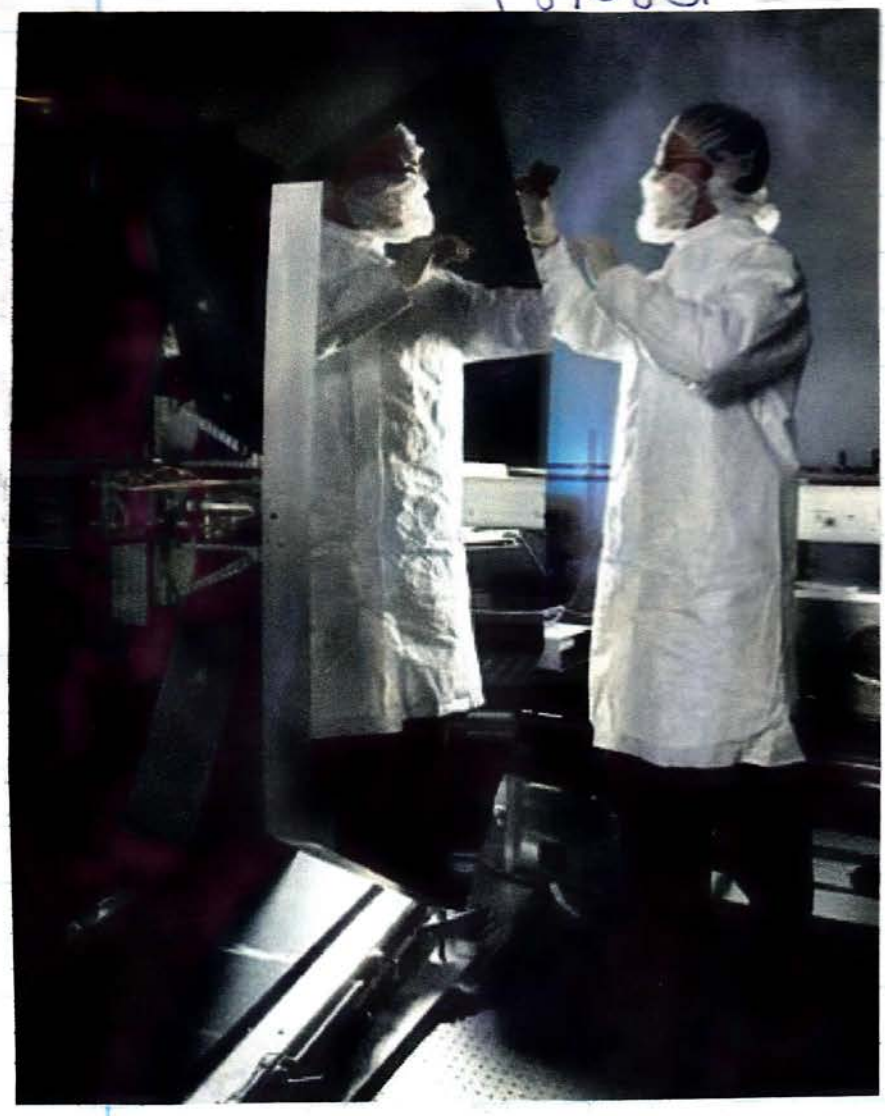
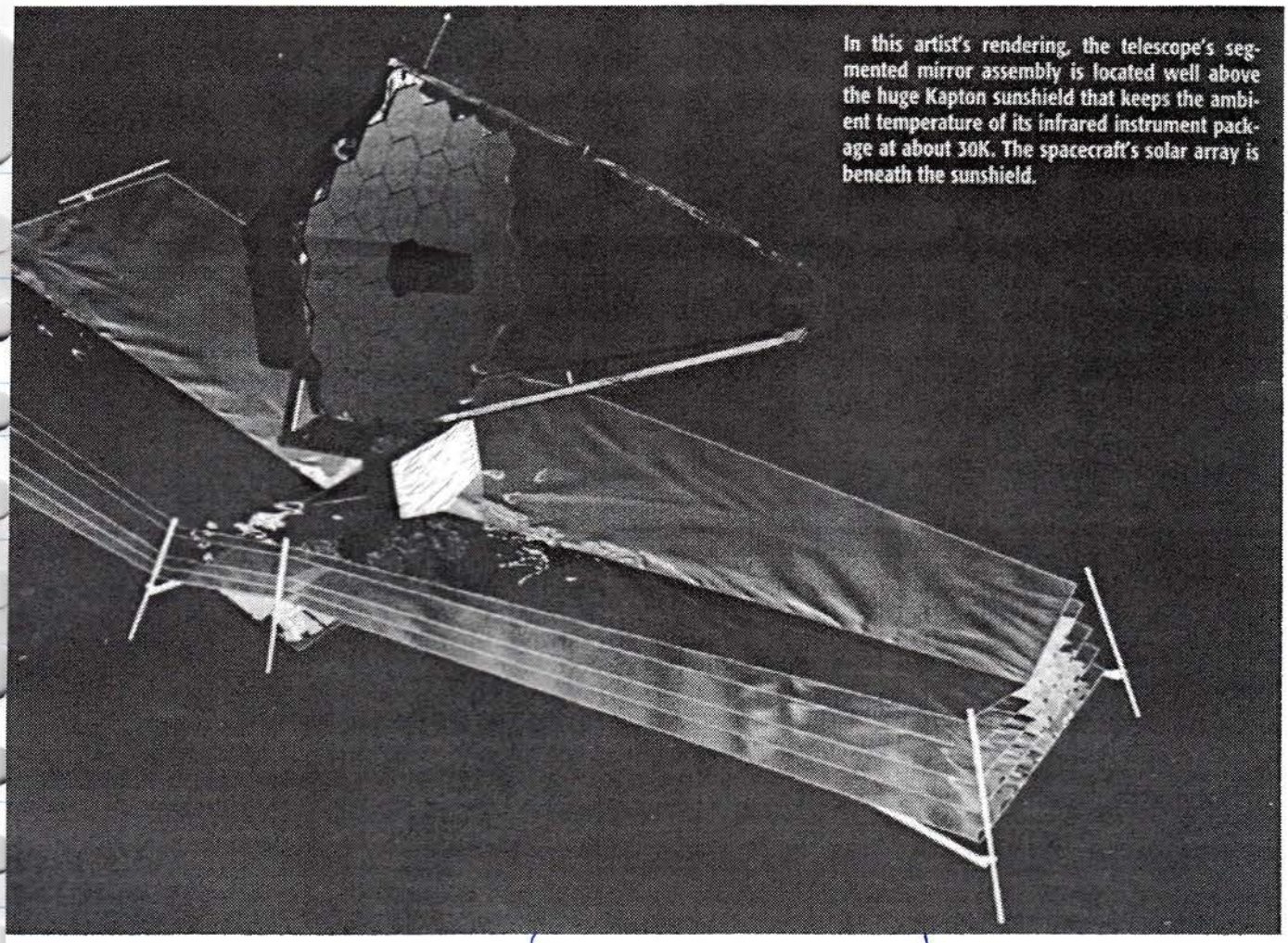


De nieuwe ruimteles

81081

Over acht jaar, in augustus 2011, mag een Ariane 5 raket de opvolger van de Hubble ruimtetelescoop lanceren. Nortrop Grumman Space Technology kwam als overwinnaar uit de lange selectieronde te voorschijn. De *James Webb Space Telescope* (vernoemd naar de grote man achter het Apollo maanproject) zal naar ht tweede Lagrangepunt (L2) op 1,5 miljoen kilometer van de aarde geschoten worden. Daar zal het 5400 kg wegende observatorium noch naar de aarde noch naar de zon vallen. Het is het punt waar aarde en zon evenhard aan de sonde trekken. Een ideaal punt ook wat de temperatuur betreft. Daar kan de telescoop en de ISIM (Integrated Science Instrument module) verzekerd zijn van 30 tot 35 gr. K. Dat wordt bereikt

22312



In this artist's rendering, the telescope's segmented mirror assembly is located well above the huge Kapton sunshield that keeps the ambient temperature of its infrared instrument package at about 30K. The spacecraft's solar array is beneath the sunshield.

81082

coop

door 5 lagen afschermingsschilden, die elk net zo groot zijn als twee tennisvelden. Koud genoeg om met zeer gevoelige infrarood sensoren die 'warmtebronnen' te vinden die zo'n 14 miljard jaar geleden ontstaan zijn. Dat is het moment dat astronomen denken dat toen de grote Oerknal ontstond. Dat zou fantastisch zijn. In grote lijnen zou de legpuzzel ingevuld worden hoe het heelal evolueerde.

In grote lijnen weten technici wel hoe de JWST eruit komt te zien. De details behoeven nog invulling. Zal de hoofdspiegel uit 18 of 30 segmenten bestaan? Over één zaak is iedereen het wel eens: alle instrumenten zullen zeer uitvoerig getest worden. De grote aanvangsproblemen bij de Hubble telescoop mogen nu onder geen beding voorkomen.

81083

Helemaal piksplinternieuw is het systeem van de nieuwe telescoop ook weer niet. Zo zijn er succesvolle systemen uit de Chandra X Ray Observatorium en de Compton Gamma Ray Observatorium overgenomen. Maar ook uit de National Polar-Orbiting Operational Environmental Satellite System. Uiteraard zijn al die systemen sterk verbeterd.

In tegenstelling tot de Hubble opereert de nieuwe veel meer in het infrarood gebied. Dat is vooral nodig om door de dichte, stoffige wolken heen te kunnen dringen, daar waar nieuwe planeten en sterren gevormd worden.

Er is ook een groot verschil in gewicht: de JWST weegt meer

81084

dan de helft minder dan de Hubble met een gewicht van ruim 13.000 kg. En wat de spiegel betreft liefst een derde. Met een doorsnede van de spiegel van 6,5 meter is dat 2,5 maal die van de Hubble. De lichtgevoeligheid is zelfs 60 keer groter. Vergeleken met die op de grond dan komt dat neer op tenminste 600 maal sterker. Doch het gaat niet om groter, maar om kouder.

De JWST is daarom tot zeer grote prestaties in staat en wetenschappers hebben geen idee wat ze straks te zien zullen krijgen. Aangezien het een internationaal project is (ESA, NASA en de Canadese ruimtevaartorganisatie) kijkt de hele wereld uit naar het moment dat deze telescoop in werking treedt.

81085

22313

Jupiter mission plans for 2011

False colour image of a convective thunderstorm 10,000 kilometres (6218 miles) northwest of Jupiter's Great Red Spot obtained by NASA's Galileo spacecraft on 26 June 1996. NASA's new Jupiter mission is set to explore the Jovian moons. NASA

81086

NASA's Jet Propulsion Laboratory has awarded a Boeing-led team a contract, with a potential value of $11 million, to study deep space propulsion systems for the Jupiter Icy Moons Orbiter (JIMO) to be launched in no earlier than 2011.

JIMO will be the first science mission in NASA's Project Prometheus, an initiative to develop nuclear power and electric propulsion systems. Four Boeing divisions, BWX Technologies and Ball Aerospace will study technology options for the reactor, power conversion, electric propulsion and other subsystems.

NASA will select the prime contractor for JIMO, which is to explore the Jovian moons, Callisto, Europa and Ganymede, in 2004. The JIMO reactor will provide 100 times more useable onboard power than previous deep space explorers, such as the Pioneers and Voyagers launched in the 1970s which were equipped with radioisotope thermoelectric generators powered by the decay of plutonium.

81087

NASA, its International Space Station partners and ISS prime contractor Boeing completed a Multi-Element Integrated Test of Japan's Kibo pressurized module and the Italian-built Node 2 where Kibo will connect with the station. The three-week test at Kennedy Space Center, Fla., demonstrated interfaces supporting in-orbit activation, audio and video control, and life-support caution and warning systems.

81088

Kibo op Kennedy Space Center

De Japanse bijdrage aan het Internationaal Ruimtestation, de Kibo drukmodule, is op 30 mei op Kennedy Space Center gearriveerd. Hier zal het, alvorens het in 2005-06 wordt gelanceerd, de nodige testen ondergaan. Het is in Japan zelf al een jaar lang uitvoerig getest.
Aan de 15 ton wegende module is bijna 17 jaar gewerkt en is een deel van de 3 miljard euro die dat land bijdraagt aan de bouw van de ISS.

22314

Explosieve ster vreet planeten

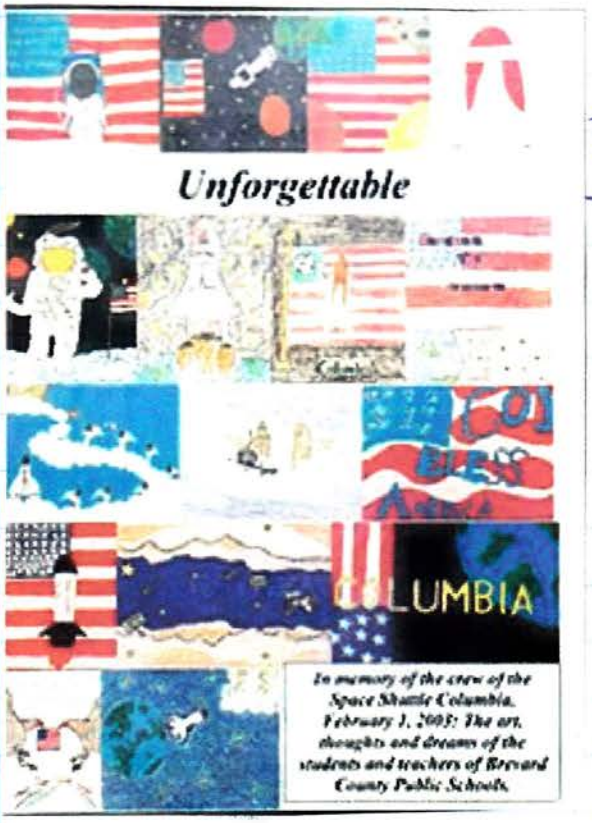
Sterrenkundigen zijn mogelijk getuige geweest van de gewelddadige dood van drie reuzenplaneten. Die zouden zijn opgeslokt door hun moederster, die aan het eind van zijn leven enorm opzwol en de planeten een voor een verorberde. Die opzienbarende theorie wordt binnenkort gepubliceerd in het Britse tijdschrift *Monthly Notices of the Royal Astronomical Society*.

De ster in kwestie, V838 Monocerotis, vertoonde in januari 2002 een ongewone helderheidsuitbarsting, en was even de helderste ster in het Melkwegstelsel. Met de Hubble Space Telescope werden later bijzondere lichtecho's rond de ster waargenomen, waaruit blijkt dat hij omgeven wordt door concentrische schillen van gas en stof.

Volgens Alon Retter en Ariel Marom van de Universiteit van Sydney is het merkwaardige helderheidsverloop van de explosie, met drie afzonderlijke pieken, met geen enkel bestaand sterrenkundig model te verklaren. In hun artikel suggereren de twee astronomen nu dat de opzwellende ster drie Jupiter-achtige planeten soldaat heeft gemaakt. De zwaartekrachtenergie die daarbij vrijkwam, zou grotendeels in straling zijn omgezet.

Volkskrant; 20-09-2003.

§1089



§1091

Saturnus-sonde bewijst Einstein

De zwaartekracht-theorie van Albert Einstein is nog exacter juist dan fysici tot nog toe al hoopten. Een nieuwe test, met behulp van radiosignalen van het ruimtevaartuig Cassini, geeft aan dat deze algemene relativiteitstheorie tot vijf cijfers achter de komma voorspelt hoe grote massa's de ruimte verwringen. Dat is zeker twee plaatsen achter de komma preciezer dan metingen tot nog toe hadden kunnen aantonen.

Cassini, een in 1997 gelanceerde Amerikaanse sonde die bestemd is om de planeet Saturnus te onderzoeken, vloog tussen 6 juni en 7 juli 2002 vanuit de aarde gezien vrijwel achter de zon langs. Volgens de algemene relativiteitstheorie vervormt een grote massa als de zon de ruimte in zijn omgeving, ongeveer zoals een zware bal op een trampoline indeukt.

Daardoor volgen fotonen of radiogolven geen recht, maar een gekromd pad, waardoor de bron ogenschijnlijk op een afwijkende plaats staat. Bovendien veranderen de frequenties van de signalen. Einstein gaf in 1915 als eerste aan hoe groot die afwijkingen zijn.

In 1919 werd tijdens een zonsverduisteringen voor het eerst vastgesteld dat het licht van verre sterren vlakbij de zonneschijf inderdaad wat wordt weggebogen. Dat werd gezien als het spectaculaire bewijs

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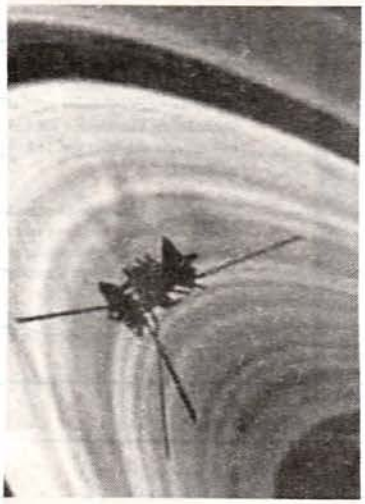


Cassini bij Saturnus. ILL. NASA

voor het gelijk van Einstein. Maar de meetnauwkeurigheid liet nog ver te wensen over.

Uit analyses van de radiosignalen gedurende de zonne-passage van Cassini maken Italiaanse onderzoekers op dat de afwijkingen van de theoretische voorspellingen nergens groter waren dan 2,1 plus of min 2,3 duizendste procent. Al meer dan twee decennia durfden experimentatoren niet verder te gaan dan 0,1 procent nauwkeurigheid, schrijven ze in het Britse weekblad *Nature* van 25 september. 'Die barrière is met de Cassini-missie nu genomen', schrijven ze.

Volks-krant; 27-09-'03

22315

SPACE TELESCOPE SCIENCE INSTITUTE NEWS RELEASE : 25 SEPTEMBER 2003.

HUBBLE UNCOVERS URANUS SMALLEST MOONS YET SEEN.

Astronomers have discovered two of the smallest moons yet found around Uranus. The new moons, uncovered by NASA's Hubble Space Telescope, are about 8 to 10 miles across (12 to 16 km) – about the size of San Francisco. The two moons are so faint they eluded detection by the Voyager 2 spacecraft, which discovered 10 small satellites when it flew by the gas giant planet in 1986. The newly detected moons are orbiting even closer to the planet than the five major Uranian satellites, which are several hundred miles wide. The two new satellites are the first inner moons of Uranus discovered from an Earth-based telescope in more than 50 years. The International Astronomical Union (IAU) will announce the finding today. The Hubble telescope observations also helped astronomers confirm the discovery of another tiny moon that had originally been spotted in Voyager pictures. "It's a testament to how much our Earth-based instruments have improved in 20 plus years that we can now see such faint objects 1.7 billion miles (2.8 billion km) away," says Mark Showalter, a senior research associate at Stanford University in Stanford, Calif., who works at the NASA Ames Research Center, in Moffett Field, Calif. Showalter and Jack Lissauer, a research scientist at the NASA Ames Research Center, used Hubble's Advanced Camera for Surveys (ACS) to make the discovery. The images were taken Aug. 25, 2003. The newly discovered moons are temporarily designated as S/2003 U 1 and S/2003 U 2 until the IAU formally approves their discovery. S/2003 U 1 is the larger of the two moons, measuring 10 miles (16 km) across. The Hubble telescope spotted this moon orbiting between the moons Puck, the largest satellite found by Voyager, and Miranda, the innermost of the five largest Uranian satellites. Astronomers previously thought this region was empty space. S/2003 U 1 is 60,600 miles (97,700 km) away from Uranus, whirling around the giant planet in 22 hours and 9 minutes. The smallest Uranian moon yet found, S/2003 U 2, is 8 miles (12 km) wide. Its orbital path is just 200 to 450 miles (300 to 700 km) from the moon Belinda. S/2003 U 2 is 46,400 miles (74,800 km) away from Uranus and circles the planet in 14 hours and 50 minutes. The tiny moon is part of a densely crowded field of 11 other moons, all discovered from pictures taken by the Voyager spacecraft. "The inner swarm of 13 satellites is unlike any other system of planetary moons," says co-investigator Jack Lissauer. "The larger moons must be gravitationally perturbing the smaller moons. The region is so crowded that these moons could be gravitationally unstable. So, we are trying to understand how the moons can coexist with each other." One idea is that some of the moons are young and formed through collisions with wayward comets. For example, the Hubble telescope spotted two small moons orbiting very close to the moon Belinda. One of them is the newly detected moon, S/2003 U 2, which is traveling inside Belinda's orbit. The other, designated S/1986 U 10, was found in 1999 by astronomer Erich Karkoschka of the University of Arizona, who uncovered the satellite in Voyager pictures. But the finding required confirmation by an Earth-based telescope. This is the first time this moon has been seen since Voyager snapped a picture of it. S/1986 U 10 is 750 miles (1,200 km) away from Belinda. "Not all of Uranus's satellites formed over 4 billion years ago when the planet formed," Lissauer says. "The two small moons orbiting close to Belinda, for example, probably were once part of Belinda. They broke off when a comet smashed into Belinda." The astronomers hope to refine the orbits of the newly discovered moons with further observations. "The orbits will show how the moons interact with one another, perhaps showing how such a crowded system of satellites can be stabilized," Showalter explains. "This could provide further insight into how the moon system formed. Refining their orbits also could reveal whether these moons have any special role in confining or 'shepherding' Uranus's 10 narrow rings." Astronomers stretched the limit of Hubble's ACS to find the tiny satellites. "These moons are 40 million times fainter than Uranus," Showalter says. "The moons are at 25th magnitude and Uranus is at sixth magnitude. They are blacker than asphalt, if their composition is like the other small, inner moons. So they don't reflect much light. Even with the sensitivity and high resolution of Hubble's ACS, we had to overexpose the images of Uranus to pinpoint the moons." The newly detected moons, when approved by the IAU, will bring the Uranian satellite total to 24. Uranus ranks third in the number of IAU-certified moons behind Jupiter (38) and Saturn (30). Excluding the outer moons that travel in elongated orbits and are probably captured asteroids, Uranus holds the record for the most satellites with 18 in its inner system. All of them have nearly circular orbits. Saturn is second with 17. The Space Telescope Science Institute (STScI) is operated by the Association of Universities for Research in Astronomy, Inc. (AURA), for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency (ESA).

81092

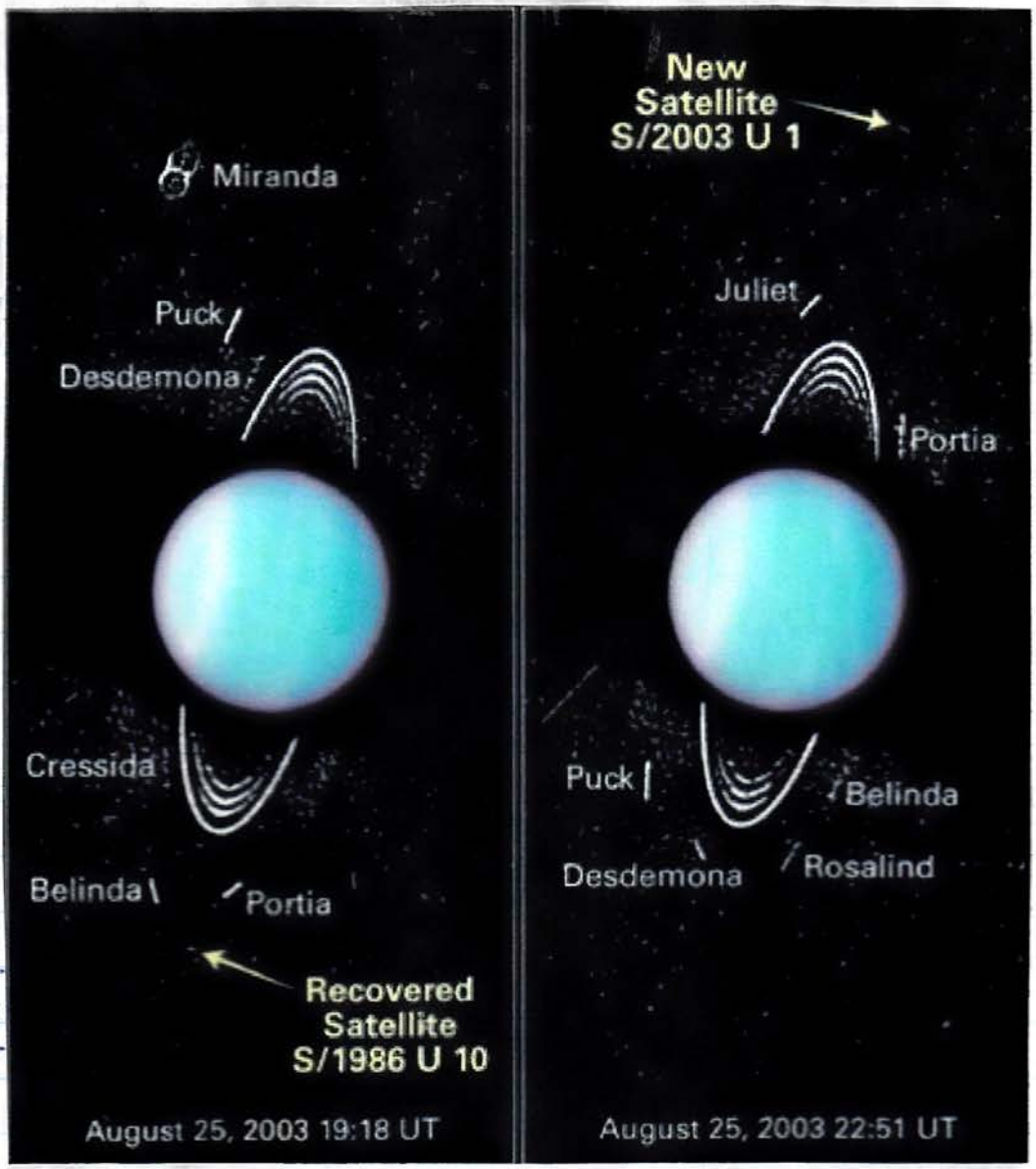
Bericht uit de ruimte
Nummer 42 - 26 september 2003

81093

Het Internationale Ruimtestation

Het International Space Station wordt bewoond door de Expeditie-7, bestaande uit de Rus Yuri Malenchenko en de Amerikaan Edward Lu. Op 29 augustus om 01:48 uur werd vanaf de basis Baykonur de Progress M-48 richting het ruimtestation gelanceerd. De Progress heeft voedsel, water en zuurstof aan boord voor zowel de Expeditie-7 als de in oktober te lanceren Expeditie-8 bemanning. Ook was de kleding voor de Expeditie-8 aan boord van de bevoorrader, alsmede een satelliettelefoon voor Malenchenko en Lu. Zij zullen deze gebruiken tijdens de landing van hun Soyuz TMA-2 in oktober. In mei raakte de Soyuz TMA-1 flink uit de koers tijdens de landing, en had men gedurende enkele uren nodig om de capsule en de bemanning te traceren. Op 31 augustus koppelde de Progress M-48 aan de Zvezda module.Op 4 september ontkoppelde de oude vrachtvaarder Progress M1-10 van de Pirs module. In tegenstelling tot de normale Progress missies, zou de M1-10 nog een maand autonoom van het ISS vliegen om haar camera te gebruiken in een aardobservatie-experiment.

22316



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81095

Cassini bevestigt relativiteitstheorie met ongekende precisie

Dankzij het ruimtevaartuig Cassini is de Algemene Relativiteitstheorie met niet eerder vertoonde nauwkeurigheid beproefd – en in orde bevonden. In vergelijking met eerdere tests gaat het om een verbetering met een factor 50 (*Nature*, 25 sept.).

Einsteins theorie van de zwaartekracht, opgesteld in 1915, voorspelt dat licht (elektromagnetische golven) dat vlak langs de zon scheert een afbuiging én een vertraging ondergaat. Het gaat om een minuscuul effect dat zijn oorzaak vindt in de kromming van de ruimtetijd in de directe nabijheid van zware massa's. Tijdens een zonsverduisteringexpeditie in 1919 werd het effect door de Britse sterrenkundige Eddington bevestigd, waarmee Einsteins doorbraak naar het grote publiek een feit was. Ook latere experimenten steunden Einstein, waarbij de nauwkeurigheid klom naar 0,1 procent. Drie Italiaanse astrofysici hebben deze marge nog eens flink weten terug te schroeven. Daarbij keken ze niet naar de afbuiging maar naar de verandering in frequentie: het Dopplereffect. Hun waarnemingen maakten gebruik van Cassini, de satelliet die na een reis van zeven jaar komende maand juli bij Saturnus hoopt aan te komen. Juni vorig jaar stonden aarde, zon en Cassini op één lijn en door te meten hoe radiogolven die tussen het grondstation in Californië en de Cassini-antenne heen en weer liepen in frequentie veranderden, konden de Italianen nagaan of de voorspelling van de Relativiteitstheorie strookte met de uitkomsten van het experiment. De methode, waarbij frequentieverschuivingen van 1 op 100 biljoen konden worden vastgesteld, was tot voor kort onbruikbaar vanwege de ruis waarmee de corona, de hete buitenmantel van de zon, het signaal overspoelde. Dat probleem wisten de Italianen als eersten te omzeilen.

Uit de gemeten frequentieverschuiving, na correcties voor de aardatmosfeer en niet-gravitatiekrachten op de Cassini, bepaalden de onderzoekers de waarde van γ. Die parameter is 1 in de Relativiteitstheorie en 0 in de newtoniaanse fysica. De uitkomst: $1 + (2{,}1 \pm 2{,}3) \times 10^{-5}$. Anders gezegd: Einstein heeft het binnen een marge van 1 op de 50.000 bij het rechte eind. Dat is zo nauwkeurig dat afwijkingen van de Algemene Relativiteitstheorie die sommige kosmologische theorieën voorspellen in beeld beginnen te komen – als ze er zijn.

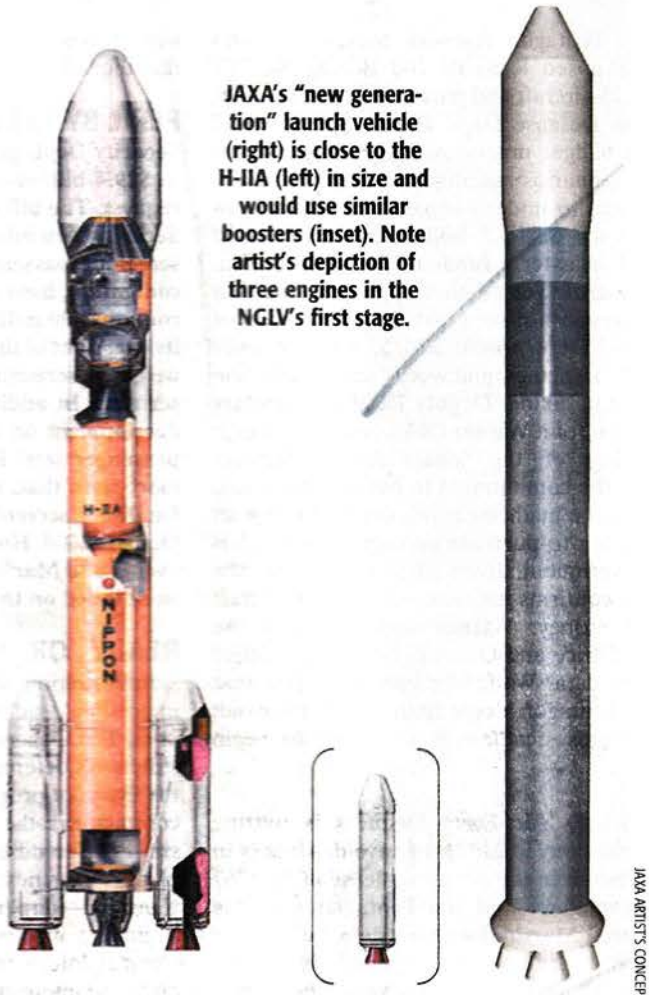
NRC Handelsblad: 27-09-2003.

22317

NEW START,

As the Japan Aerospace Exploration Agency consolidates the nation's space activities, Japanese launch teams have their eye on a Delta IV-class program

EIICHIRO SEKIGAWA/TOKYO and MICHAEL MECHAM/SAN FRANCISCO



JAXA's "new generation" launch vehicle (right) is close to the H-IIA (left) in size and would use similar boosters (inset). Note artist's depiction of three engines in the NGLV's first stage.

JAXA ARTIST'S CONCEPT

In addition to a higher capacity version of the H-IIA, Japan's aeronautical establishment is intent on drawing from that exercise to develop an entirely new heavy-lift launch vehicle in the next decade.

As yet unnamed, this "new generation" launch vehicle (NGLV) is expected to emerge 10% lighter than the 285-metric-ton H-IIA and, at 55 meters (180 ft.), 2 meters longer. Like the H-IIA, it is to have two cryogenic stages with multiple mix capabilities for strap-on boosters. But the NGLV is to have 10-20% greater lift capacity than its predecessor.

The concept was introduced here this month by Shuichiro Yamanouchi, the incoming managing director of the Japan Aerospace Exploration Agency (JAXA), which will officially come into being on Oct. 1. He did not offer a projection of the NGLV's development costs.

Yamanouchi, a former chairman of the East Japan Passenger Railway Corp. who became managing director of the National Space Development Agency three years ago, said NASDA's development work on the H-IIA meant that Japan is "no longer chasing U.S. and European technologies."

That view is not surprising and is shared by Asia's other space leaders, China and India. All three countries have incorporated Western technology in their satellite and/or launcher programs, and they have or plan to be partners on various Western space projects. Their efforts are not a race in the sense that the former Soviet Union and the U.S. "raced" to the Moon. And their goals are more "inward-looking," in that each country wants both a manufacturing capability that gives it independent access to space while achieving world standing.

As the region's longtime leader in space technology, Japan has developed the H-II family to fulfill that aim, even as Japanese scientists and industry cooperate with Europe and the U.S. on a variety of international programs.

Still, Yamanouchi said Japan doesn't need to try to match everything Europe and the U.S. have. While he described a general requirement for greater lift capacity that apparently is to exceed a plan already approved, he said Japan doesn't need a vehicle quite as big as the European Ariane 5.

But JAXA appears to be gaining two Delta IV-class vehicles. The cabinet-level Space Activities Commission recently approved a heavier lift version of the H-IIA, the second major upgrade to that launcher since its debut a decade ago (*AW&ST* Sept. 1, p. 38). It isn't clear where the cross-over point between the modified H-IIA and the NGLV will be.

Aside from added lift, Yamanouchi emphasized that the new launcher will continue Japan's ability to develop launchers independently. He added that Japan is pursuing a long-held goal of exceeding European and U.S. launchers in terms of reliability. That was the goal of the H-II program when it began nearly a decade ago, but it suffered technical teething problems, just as U.S. and European programs have.

JAXA is very ambitious in terms of launch cost and order-to-delivery schedules. The agency's goal is to cut launch costs from 8.5 billion yen ($75 million) for the current H-IIA to 4-5 billion yen on the new vehicle.

Targets for cost reduction will be improved engine reliability through refined failure analysis, a simplified airframe structure, launch facility and design interfaces. With similar goals in mind,

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22318

BIG START

Japan redesigned the H-II to create the H-IIA, but in the process turned away from some of the early all-Japanese cryogenic engine and tank designs to incorporate U.S. material and design elements. The result has been a vehicle that is cheaper to manufacture and launch.

Yamanouchi said the NGLV will vary from previous programs in another important fashion: it is to be a government-industry project. Government agencies have headed past development programs. But the H-IIA is now operated by a team headed by Mitsubishi Heavy Industries, so Yamanouchi's comment is within that parameter.

JAXA consolidates the activities of NASDA, the Institute of Space and Astronautical Science (ISAS) and the National Aerospace Laboratory (NAL) into a single, all-encompassing space agency. Each of its predecessors had a specialty. While their activities occasionally overlapped, they stayed mainly within their own fields.

JAXA will have four major divisions:

- The Office of Space Flight and Operations.
- The Office of Space Applications.
- The Institute of Space Technology and Aeronautics.
- The Institute of Space and Astronautical Science.

The first two generally describe NASDA's previous responsibilities; the third reflects NAL's previous job, and the latter corresponds to ISAS' old mandate (*AW&ST* June 9, p. 34).

Other than those divisions, JAXA will have a special office, controlled directly by the managing director, that will promote cooperation with industry and the academic community. The office's goals include improving JAXA's ability to transfer its technology into industry. The new agency inherits some 500 patents developed specifically for space use.

OTHER THAN RUNNING Japan's launch vehicle program, one of JAXA's key missions will be contributions to environmental studies, Yamanouchi said. The new agency inherits a team accustomed to doing top-grade Earth-observation missions and the agency wants to keep a leadership position in observations technologies for rain and emissions studies, especially of carbon dioxide. Weather, natural disaster monitoring and global-positioning services will be priorities, he said.

But the new agency also will emphasize an unprecedented role that regional events thrust upon NASDA in the past few years, that of using military reconnaissance satellites for national security purposes. Under NASDA's direction, Japan has developed four reconnaissance satellites, two of which already are in orbit. (The other two—Optical-2 and Radar-2—were due for launch Sept. 22 on the sixth H-IIA mission, but the liftoff has been delayed until later in the month. Satellite checkouts have prompted previous delays.)

When JAXA officially opens its doors this week, it will have a number of key missions in the works, including the Advanced Land Observing Satellite, the Winds wideband Internet working demonstration satellite, the Astro-E2 large X-ray telescope, the Astro-F infrared-source survey mission, the Solar-B precision Sun-observation mission and the Lunar-A and Selene Moon survey missions. Additionally, JAXA intends to work on technology on behalf of Japanese industry to challenge the world's leading space-based mobile communications and high-resolution Earth-observation systems.

JAXA will have 17 offices, laboratories, institutes, experiment sites and other facilities, including launch sites at Uchinoura and Tanegashima. Its present workforce is about 1,800 employees, although a restructuring effort aims to reduce that to 1,000 or fewer. Budget totals for NASDA, ISAS and NAL are about $1.6 billion in fiscal 2003. Their consolidation into JAXA is accompanied by a 200-billion-yen request for fiscal 2004, which begins next Apr. 1.

810 97

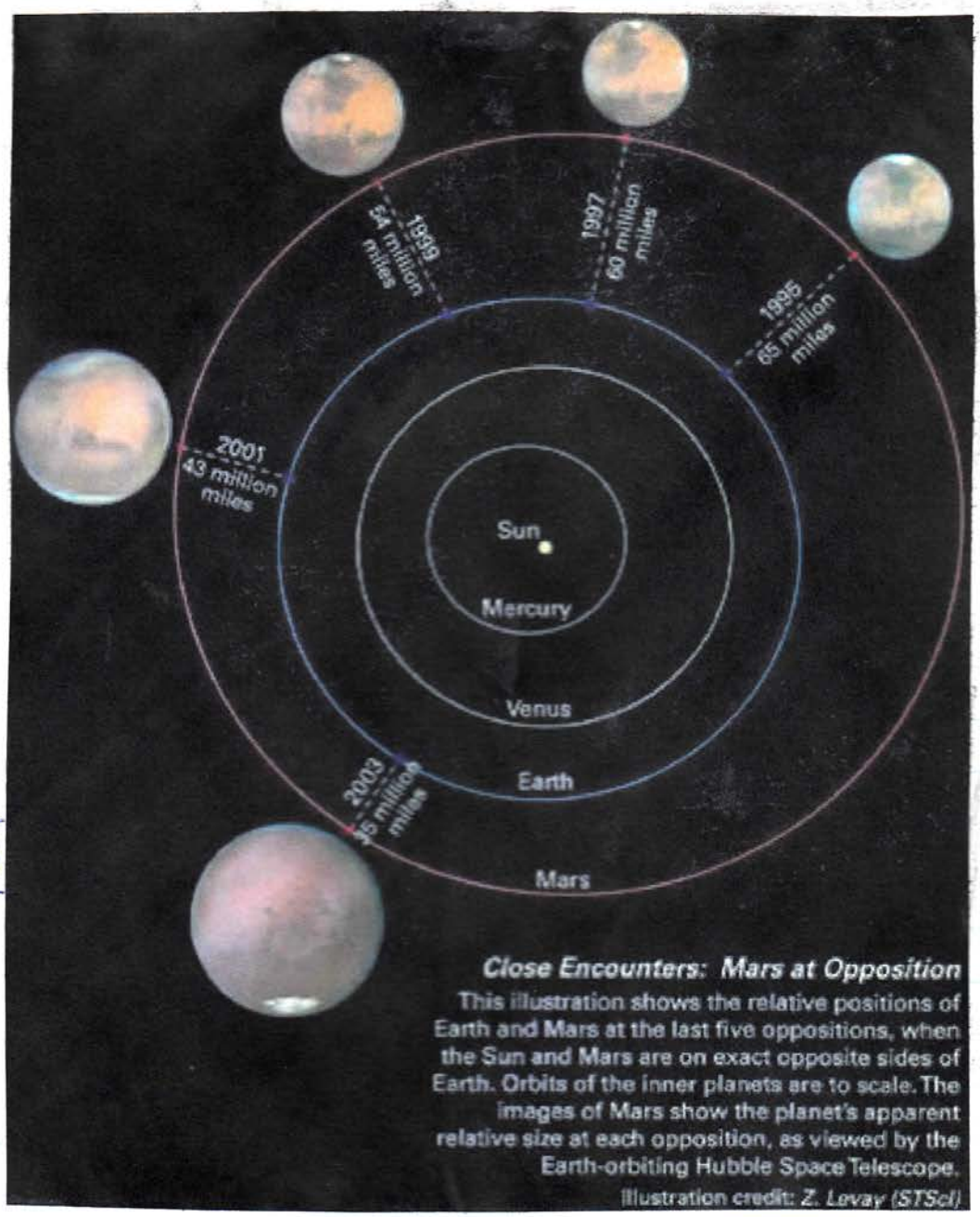
AP NEWS : 26 AUGUSTUS 2003.

HUBBLE'S CLOSEUP PHOTOS OF MARS TO BE RELEASED.

81098

BALTIMORE - As Mars and Earth reach their closest encounter in 60,000 years this week, the Hubble Space Telescope will be shooting pictures that scientists predict will be "spectacular." The first images showing surface details as small as 17 miles across were to be taken Tuesday night when Mars is 34.6 million miles from Earth. A full-color photograph of the planet made from those images will be released for the world to see early today. "Of course, what people will care most about are the pretty pictures, and they will be spectacular," said Jim Bell of Cornell University, who is leading one of the teams collecting Mars data from the Hubble. "The pictures we take this week are probably the ones that will be in astronomy textbooks for the next several decades." A second set of images taken within an hour of Mars' closest approach today will show Mars 1,400 miles closer. The photos are stored in an onboard computer before they are transmitted to the Goddard Space Flight Center in Greenbelt, Md., and eventually to the Space Telescope Science Institute in Baltimore, which will release the images. This week's pictures will be the sharpest views of Mars ever taken from Earth, or in this case, Earth's orbit. There are spacecraft orbiting Mars that are much closer, but the Hubble has capabilities those craft don't have. The space telescope, for example, can capture ultraviolet wavelengths. Free of the distorting effect of Earth's atmosphere, the Hubble is routinely used to track atmospheric changes and study Mars' geology. Ozone and water vapor in the Martian atmosphere, for example, are among the items that can be traced by examining ultraviolet light on Mars. When the Earth and Mars were in a similar position in 2001, the two planets were about 43 million miles apart, said Keith Noll, an astronomer at the Space Telescope Science Institute. While Mars is very well studied, the planet's new proximity9 million miles closer, combined with other data collected since 2001, might help researchers learn something new, Noll said.

22319



Close Encounters: Mars at Opposition

This illustration shows the relative positions of Earth and Mars at the last five oppositions, when the Sun and Mars are on exact opposite sides of Earth. Orbits of the inner planets are to scale. The images of Mars show the planet's apparent relative size at each opposition, as viewed by the Earth-orbiting Hubble Space Telescope.

Illustration credit: *Z. Levay (STScI)*

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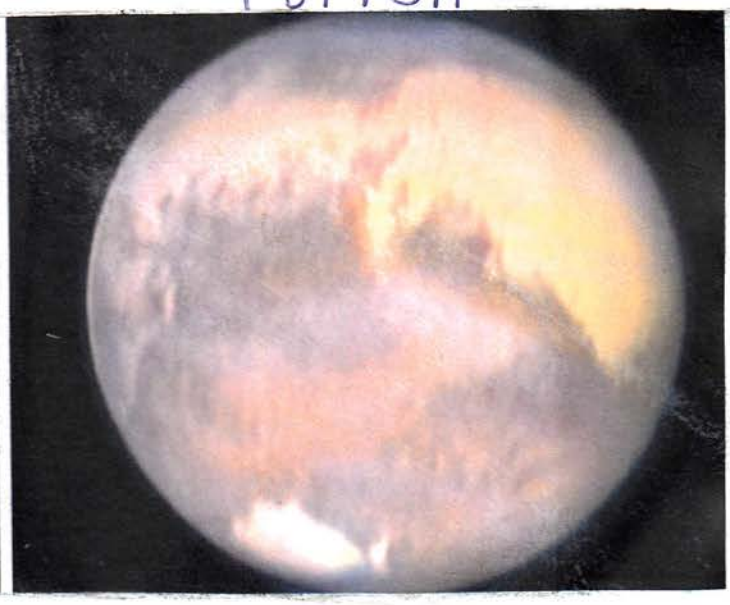

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Mars historisch dicht bij aarde

Maastricht • De laatste keer dat het gebeurde liepen de Neanderthalers nog door Europa. Maar morgenvroeg, een kleine 60.000 jaar later, staan de planeten mars en aarde wederom historisch dicht bij elkaar. Om 11.51 uur is de afstand tussen beide hemellichamen iets minder dan 56 miljoen kilometer. Nog altijd te ver om te lopen, maar op kosmische schaal minder dan een steenworp afstand. Ter vergelijking: in januari van dit jaar stonden mars en aarde nog 267 miljoen kilometer van elkaar vandaan.

Dat mars en aarde gaandeweg naar elkaar toe kruipen heeft te maken met de elliptische banen die beide planeten rond de zon maken. Die van mars is iets meer eivormig dan die van de aarde. Tegelijkertijd is de ellips van onze aarde een stuk kleiner, zodat 'wij' mars eens in de 26 maanden inhalen. Dat gebeurt bijna nooit op hetzelfde punt. Bovendien ondergaat de baan van mars door de aantrekkingskrachten van andere planeten kleine variaties. Dat verklaart waarom het tot het jaar 2287 zal duren eer aarde en mars weer zo dicht bij elkaar staan. Tegen die tijd wordt het record met nog eens 69.900 kilometer verkleind. Over de hele wereld staan tigduizenden telescopen klaar, want als het weer meezit, zal de rode planeet als helderste 'ster' aan het zuid-oostelijke firmament te zien zijn. Donderdagavond is er nog iets bijzonders: dan staan de zon, de aarde en mars op één lijn.

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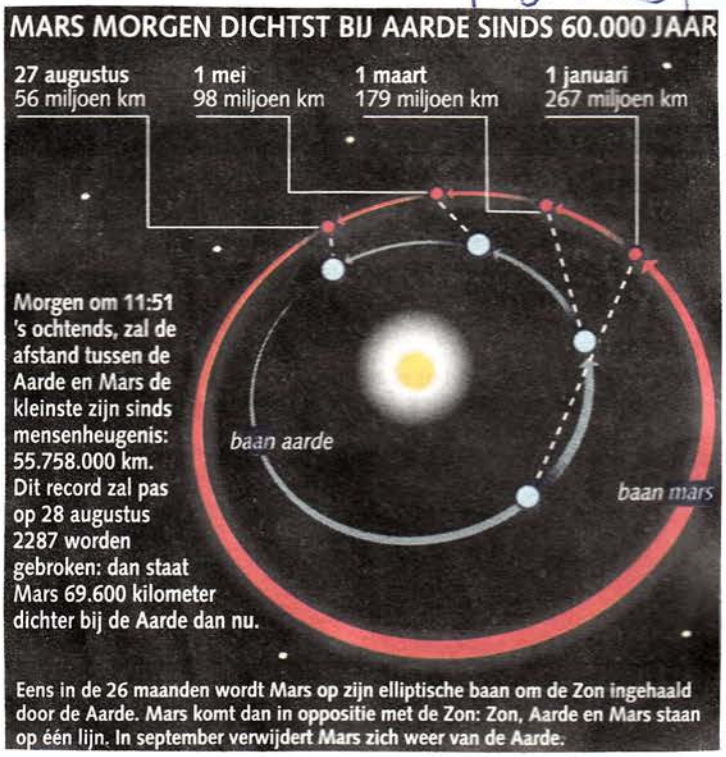

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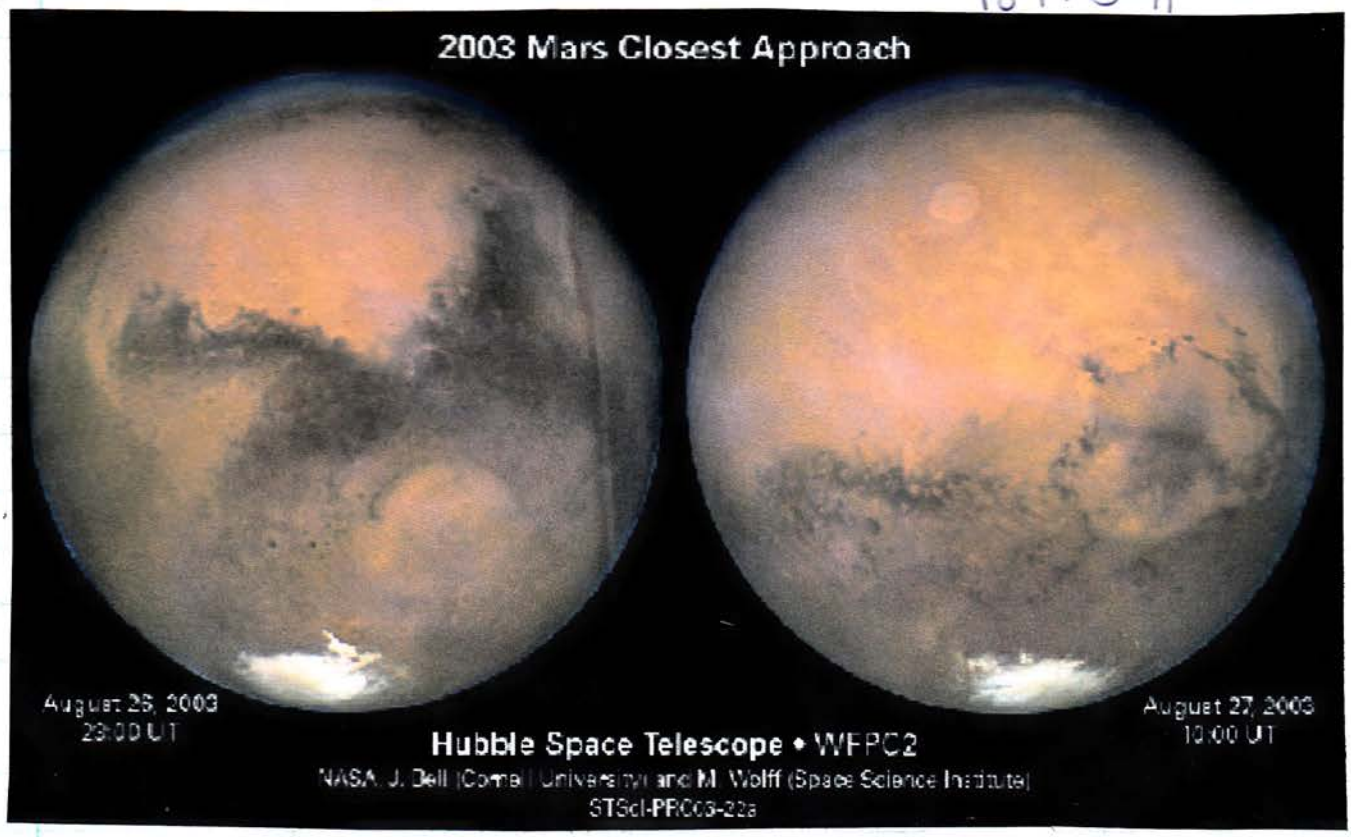

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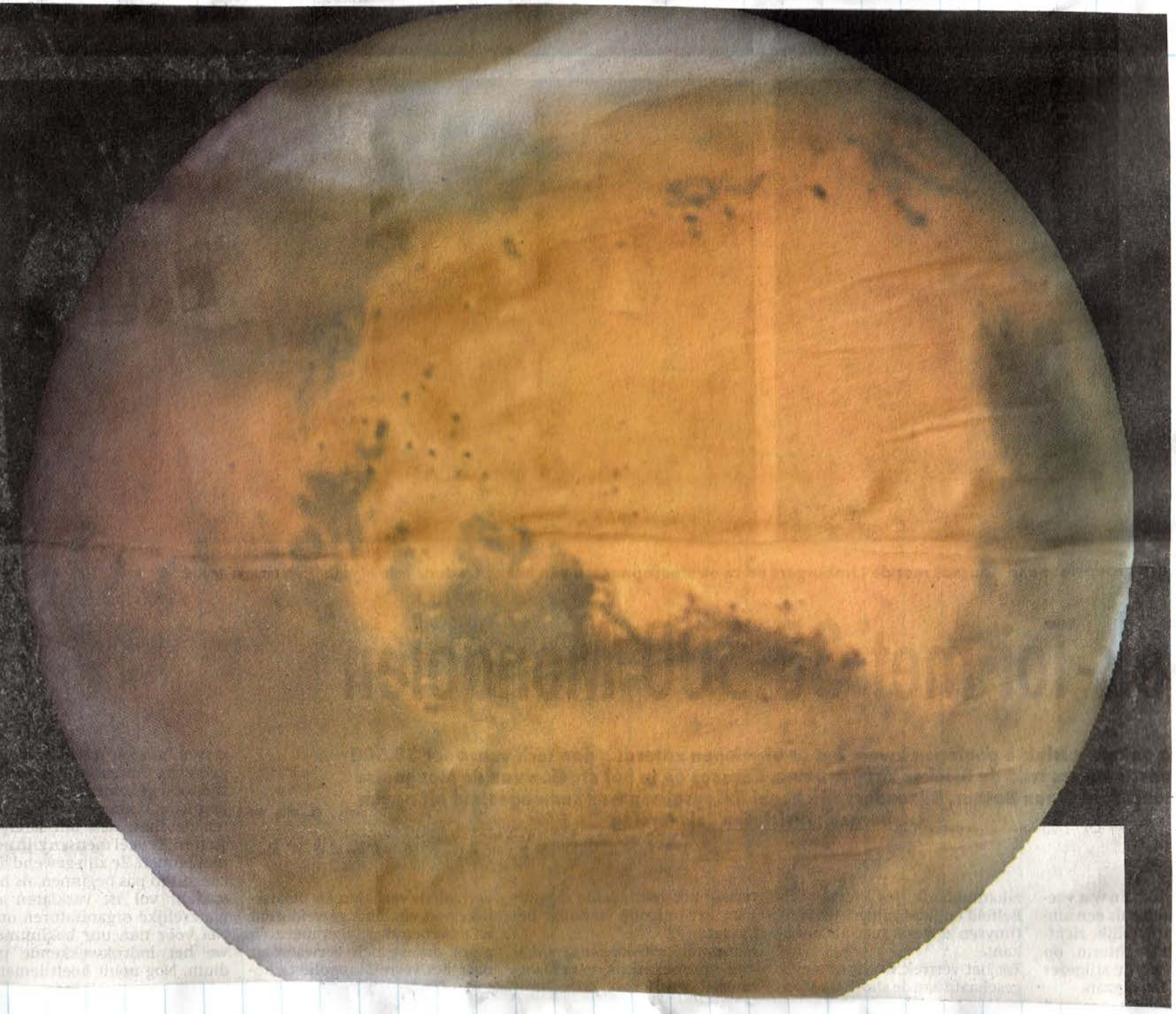
Morgen staat Mars op de kleinste afstand tot de aarde in bijna zestigduizend jaar. Overal ter wereld staan telescopen gereed. Voor Hans Goertz, amateur-sterrenkundige uit Beek, breken drukke tijden aan.



MARS SCHEERT VOORBIJ

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Wie naar het zuidoosten kijkt, kan hem onmogelijk missen. Mars is momenteel de helderste 'ster' aan het firmament. Eeuwen geleden trok het rode uiterlijk van Mars al de aandacht. Het werd geassocieerd met bloedvergieten en de Grieken en Romeinen vereenzelvigden de planeet met hun oorlogsgod. In werkelijkheid komt Mars aan zijn kleur door geoxideerd ijzer in het oppervlaktegesteente - roest dus. De grote helderheid van dit moment heeft te maken met de kleine afstand tot de aarde.
Morgenochtend, om 11.51 uur, bevindt Mars zich op 'slechts' 55.758.006 kilometer van onze planeet. Dat lijkt heel wat, maar op kosmische schaal gaat het om een *close encounter*. We moeten helemaal terug naar het jaar 57.617 vóór Christus om Mars nog dichterbij de aarde te vinden. In die tijd zwierven de Neanderthalers nog door Europa, maar helaas beschikten die niet over telescopen. In de eenentwintigste eeuw is dat anders en dus is er nu een ware Marshype uitgebroken. Wereldwijd brengen vele duizenden waarnemers hun kijkers in stelling, want de 'recordafstand' belooft een ongekend scherpe blik op de planeet.
Hans Goertz is één van hen. Deze dagen is de amateur-astronoom uit Beek veel in Genk te vinden, waar hij Mars met de grote kijker van het Europlanetarium te lijf gaat. "Wat er zo leuk is aan het observeren van planeten? Je kijkt naar andere werelden, waar zóveel verschillen met onze aarde te bespeuren zijn maar óók overeenkomsten", aldus Goertz. "Zo is de planeet Mars in veel opzichten een spiegelbeeld van de aarde, met canyons en vulkanen. Verder kun je er weersverschijnselen zoals wolken en stofstormen waarnemen. Daar een glimp van op te vangen vanuit je eigen achtertuin, dat fascineert me!"

811107

De gunstige stand van Mars hangt samen met de dans die de rode planeet samen met de aarde rond de zon opvoert. Vergelijk het met twee hardlopers op een sintelbaan. Mars loopt in de 'buitenbaan' en doet over een rondje om de zon 687 dagen. De snellere aarde draait in de 'binnenbaan', dichterbij de zon, en haalt Mars iedere 26 maanden in. Wanneer dat gebeurt, bevinden beide planeten zich in oppositie en staan ze het dichtst bij elkaar. Toch is de ene oppositie de andere niet. De baan van Mars is namelijk nogal eivormig, zodat hij zich soms dichter bij de zon bevindt dan anders. Wanneer de oppositie samenvalt met het moment dat Mars de kleinste afstand tot de zon inneemt, zoals nu het geval is, kan hij de aarde extra dicht naderen. Dit gebeurt eens in de zestien jaar en is hét uitgelezen moment om Mars met een telescoop te observeren. Door de aantrekkingskrachten van andere planeten ondergaat de baan van Mars in de loop der eeuwen kleine variaties. Daardoor kan planeet geleidelijk iets dichter bij de zon en de aarde komen. Dat verklaart het record van 2003. Pas in 2287 wordt de afstand aarde-Mars nòg kleiner.

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Voor amateurs als Hans Goertz begint nu het serieuze werk: "Door de telescoop zijn donkere vlekken op de planeet te zien, en de poolkappen. Tot voor kort legde ik alles vast op papier, tekenen dus. Tegenwoordig is de opmars van de digitale fotografie niet meer te stuiten. Amateurs kunnen nu opnamen maken waar ze tien, twintig jaar geleden niet van durfden dromen". Goertz verzamelt zoveel mogelijk waarnemingen. "In het najaar zal ik tijdens regenachtige avonden heel wat uurtjes achter de pc kruipen om de resultaten te bundelen en uit te werken tot onder meer nieuwe kaarten van Mars. Het eindproduct komt terecht in ons tijdschrift Mercurius en de beste resultaten vinden zelfs hun weg naar organisaties in het buitenland. Toch is het niet allemaal rozengeur en maneschijn", stelt Goertz. "Mars staat momenteel laag aan de hemel en dat is ongunstig. Je hebt dan veel last van luchtonrust in de aardse atmosfeer, met soms wazige beelden in de kijker als gevolg." En er is nog een risico. Vanwege de geringe afstand tot de zon ontvangt de Marsatmosfeer nu extra zonnewarmte. Daardoor kunnen er stofstormen ontstaan die soms de hele planeet omvatten. Goertz: "Dat lijkt natuurlijk spectaculair maar betekent wel dat de details op Mars enorm vervagen of zelfs helemaal verdwijnen".

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Vreemd genoeg schenken professionele sterrenkundigen slechts weinig aandacht aan de bijzondere Mars-oppositie van 2003. Ruimtesondes kunnen de planeten van dichtbij veel gedetailleerder bestuderen dan met aardse telescopen mogelijk is. Momenteel draaien twee Amerikaanse kunstmanen rond de rode planeet en een kleine armada van Europese, Japanse en Amerikaanse sondes is onderweg. Ook zal de Hubble ruimtetelescoop vanuit zijn baan rond de aarde komende dagen de planeet onder de loep nemen.
Heeft het werk van amateurs dan nog wel waarde? Hans Goertz: "Alle tekeningen en opnamen bij elkaar geven een zeer compleet beeld van wat zich op Mars afspeelt. Dat is nu juist de grote kracht van de amateurs. Sterrenwachten zijn zó druk bezet dat ze de planeten onmogelijk constant in de gaten kunnen houden. Ook ruimtesondes geven slechts een momentopname van een paar maanden tot een paar jaar. Wij als amateurs vullen deze leemten op! Maar de meeste waarnemers doen het vooral voor de 'fun' en krijgen een kick als ze een detail zoals de vulkaan *Olympus Mons* op hun digitale foto terugvinden".

DDL: 26-08-2003

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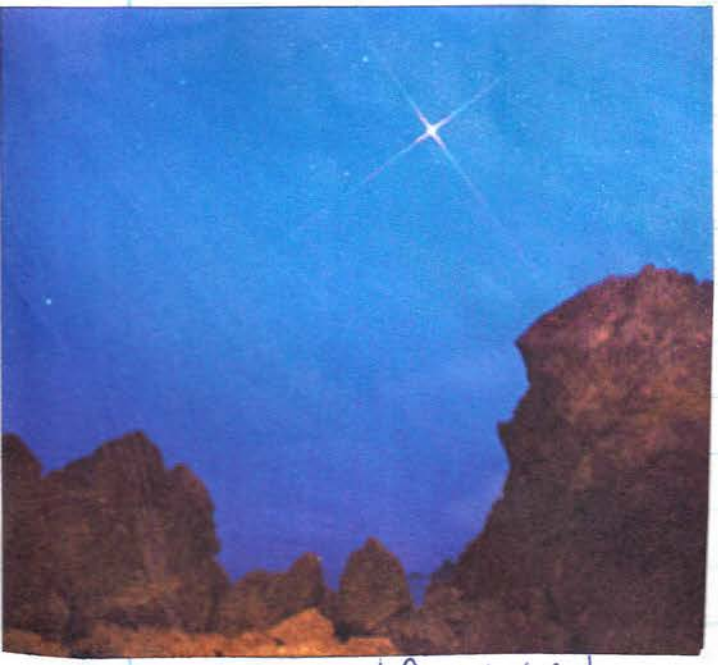

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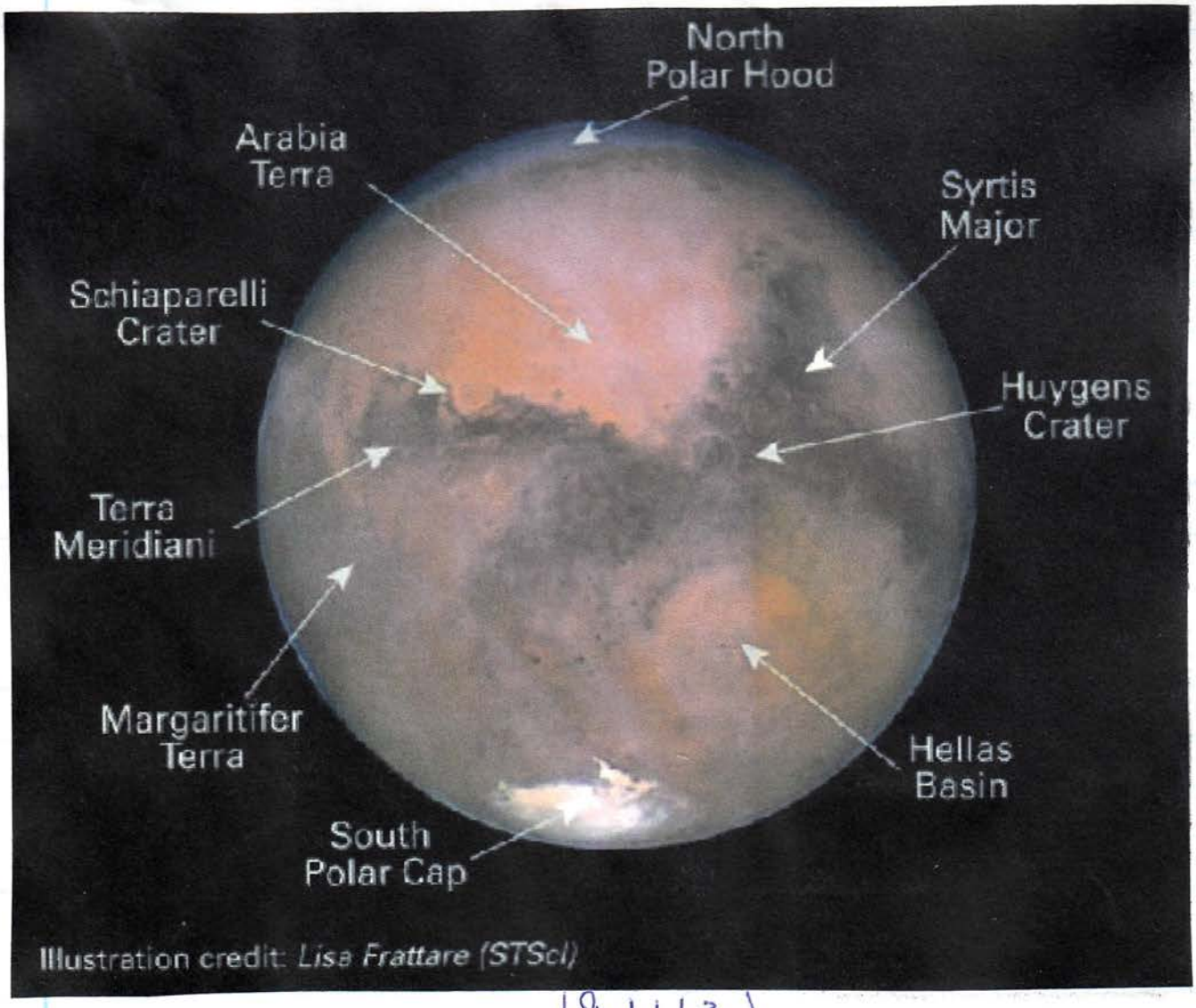

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SPACE.COM : 27 AUGUSTUS 2003.

HUBBLE MAKES BEST MARS GLOBE PHOTOS EVER.

The first of two highly anticipated Mars portraits from the Hubble Space Telescope was released this morning as the observatory's operators took advantage of a proximity to the red planet not equaled in 59,619 years.The color photograph includes Mars' Hellas Basin, a huge impact crater, and the southern polar ice cap is unmistakable. It is the most detailed full-globe shot of Mars ever obtained from Earth's vicinity. A second color image of another region of the planet will be released at 4 p.m. ET (2100 GMT) today and will be added to this report."These images are likely to be the ones that appear in astronomy textbooks for the next decade to century because they are the best resolution we can get from Earth for a long time," said Cornell University astronomer Jim Bell. Not until 2287 will the two worlds be so close again. Last night, while skywatchers around the world were staring up at Mars, Hubble spent 52 minutes gathering 10 separate exposures for the first color image. Photo experts at the Space Telescope Science Institute (STScI) scrambled to assemble the first picture and colorize it. They also had to adjust each frame to account for the fact that Mars did not sit still during the photo shoot – it was rotating upon its axis, as always. The result is a sharp image revealing details as small as 17 miles(24 kilometers) wide. Several impact craters are visible. Hellas Basin, just below and to the right of the image center, is about 1,240 miles across (2,000 kilometers) and 4.4 miles (7 kilometers) deep. It's so far down from rim to floor that sometimes pictures of it are blurry just because there is so much more air in the basin than above other parts of Mars. The basin is also frequently clouded over and thus even more obscured. But it was clear last night. The second color picture was being taken around 5:51 a.m. ET today, also during a 45-minute window, to coincide with the moment when Earth and Mars would be closest. It will show Mars' version of the Grand Canyon, called Valles Marineris, a vast system of gorges and side canyons that stretches across 2,485 miles (4,000 kilometers) of the Martian surface. Drop Valles Marineris on the United States and would reach nearly coast to coast. Mars, meanwhile, continues to beckon casual observers as well as seasoned backyard astronomers. It is the unmistakably bright "star" of the night sky now, rising in the southeast at sunset and setting in the southwest at dawn. Around midnight, it is high in the southern sky. Though Mars and Earth are now gradually drifting apart, the red planet remains at peak brightness through Sept. 2 and will be a compelling night sky target into October. Mars' orange tint, sometimes seen as red, is created by a global coating of iron oxide, commonly called rust. NASA has two orbiting spacecraft at Mars, and each can snap higher-resolution pictures compared with Hubble's effort. But the orbiters photograph just strips of Mars at a time. Even when the strips are stitched together to make a globe, the result is unnatural, showing all parts of the surface at the same time of day -- the time when the robots are in position to make images. In the case of Mars Global Surveyor, each strip of the surface is seen as of early afternoon local time on the ground. "With Hubble, you get the whole globe view of weather from the morning terminator to evening limb," Bell said in a telephone interview last week.

8114

SPACE TELESCOPE SCIENCE INSTITUTE NEWS RELEASE : 27 AUGUSTUS 2003.

HUBBLE'S CLOSEST VIEW OF MARS.

8115

NASA's Hubble Space Telescope snapped this portrait of Mars within minutes of the planet's closest approach to Earth in nearly 60,000 years. This image was made from a series of exposures taken between 5:35 a.m. and 6:20 a.m. EDT Aug. 27 with Hubble's Wide Field and Planetary Camera 2. In this picture, the red planet is 34,647,420 miles (55,757,930 km) from Earth. This sharp, natural-color view of Mars reveals several prominent Martian features, including the largest volcano in the solar system, Olympus Mons; a system of canyons called Valles Marineris; an immense dark marking called Solis Lacus; and the southern polar ice cap. Olympus Mons [the oval-shaped feature just above center] is the size of Arizona and three times higher than Mount Everest. The dormant volcano resides in a region called the Tharsis Bulge, which is about the size of the U.S. and home to several extinct volcanoes. The three Tharsis Montes volcanoes are lined up just below Olympus Mons. Faint clouds are hovering over Arsia Mons, the southernmost of these volcanoes. The long, dark scar, below and to the right of the Tharsis Bulge, is Valles Marineris, a 2,480-mile (4,000-km) system of canyons. Just below Valles Marineris is Solis Lacus, also known as the "Eye of Mars." The dark features to the left of Solis Lacus are the southern highlands, called Terra Sirenum, a region riddled with impact craters. The diameters of these craters range from 31 to 124 miles (50 to 200 km). The image was taken during the middle of summer in the Southern Hemisphere. During this season the Sun shines continuously on the southern polar ice cap, causing the cap to shrink in size [bottom of image]. The orange streaks are indications of dust activity over the polar cap. The cap is made of carbon dioxide ice and water ice, but only carbon dioxide ice is seen in this image. The water ice is buried beneath the carbon dioxide ice. It will only be revealed when the cap recedes even more over the next two months. By contrast, the Northern Hemisphere is in the midst of winter. A wave of clouds covers the northern polar ice cap and the surrounding region [top of image]. This view of Mars reveals a striking contrast between the Northern and Southern hemispheres. The Northern Hemisphere is home to volcanoes that may have been active about 1 billion years ago. These volcanoes resurfaced the north's landscape, perhaps filling in many impact craters. The Southern Hemisphere is pockmarked with ancient impact craters, which appear dark because many are filled with coarser sand-sized particles. Mars and Earth make a "close encounter" about every 26 months. These periodic encounters are due to the differences in the two planets' orbits. Earth goes around the Sun twice as fast as Mars, lapping the red planet about every two years. Both planets have elliptical orbits, so their close encounters are not always at the same distance. In its close encounter with Earth in 2001, for example, Mars was about 9 million miles farther away. Because Mars was much closer during this year's rendezvous, the planet will appeared 23 percent larger in the sky. Mars will not be this close again until 2287. This photograph is a color composite generated from observations taken with blue, green, and red filters. A total of 11 filters, spanning a wide wavelength range -- from blue to near infrared -- were used during the observations. The shorter wavelengths show clouds and other atmospheric changes. The longer wavelengths, including the near infrared, reveal Martian surface features.

22325

CNN : 28 AUGUSTUS 2003.

EARTHLINGS REVEL IN MARS CLOSE-UP.

The last time the red planet was this close to Earth 60,000 years ago, man lived in caves. No wonder when Mars and Earth synchronized their orbits a few minutes before 6 a.m. EDT Wednesday -- bringing them closer to each other than at any time in recorded history -- thousands of people around the globe went outside to take a peek. "Knowing that this is once in a lifetime that I can see another planet with the naked eye, yeah, it's great," said Rebecca Horton, a stargazer from Sydney, Australia. Astronomers say Mars, five times closer now than six months ago, is about 34.6 million miles away, making it the brightest nighttime object except the moon. "It is possible to get some fairly close encounters every few years," said amateur astronomer Paul Shallow. "It does come around, but not this close." But with the far-away planet getting so close, some hopeful watchers felt gypped by Mother Nature. In Oakland, California, where hundreds of space fans paid $11 to attend the Chabot Space & Science Center's "Mars Mania Costume Party," clouds rolled in along with night sky Tuesday. Mars was fogged out, and there were no refunds. But the good news is that Mars will remain a stunning nighttime attraction for weeks. Most sky watchers can see the planet, presently in the constellation Aquarius, in the southeastern sky soon after sunset, high overhead during the midnight hours and in the southwestern sky before sunrise. Backyard telescopes may coax features out of the reddish, orange blur, including dark, mottled streaks, which inspired scientists of past centuries to envision intricate canals and advanced Martian civilizations. The rare configuration of 2003 has stoked renewed, albeit not as fanciful, interest in Mars, which on average cruises 50 million miles farther from the sun than Earth does. About every 26 months, the two planets pass relatively close to one another, during periods now known as opposition. What makes this one noteworthy is that Mars, which follows an extremely elliptical or egg-shaped path, is currently at it closest point to the sun during its orbit. Those two conditions, along with a few obscure celestial variables, have produced an astronomical chance of a lifetime, or several lifetimes actually. Mars won't pass closer to Earth until 2287, according to astronomers. Besides awing the curious, the alignment has motivated numerous governments to dispatch missions to the red planet. Taking advantage of the shorter trip distance, two U.S. and two European probes set off earlier this year, all to arrive at the end of the year. "Mars fever has caught, not only for amateur astronomers, who are getting their best look at the planet ever and that we'll ever have in our life, but also for professionals, as you know, with the [NASA] Mars Rovers and other spacecraft that are en route," said David Eicher, editor of Astronomy magazine.

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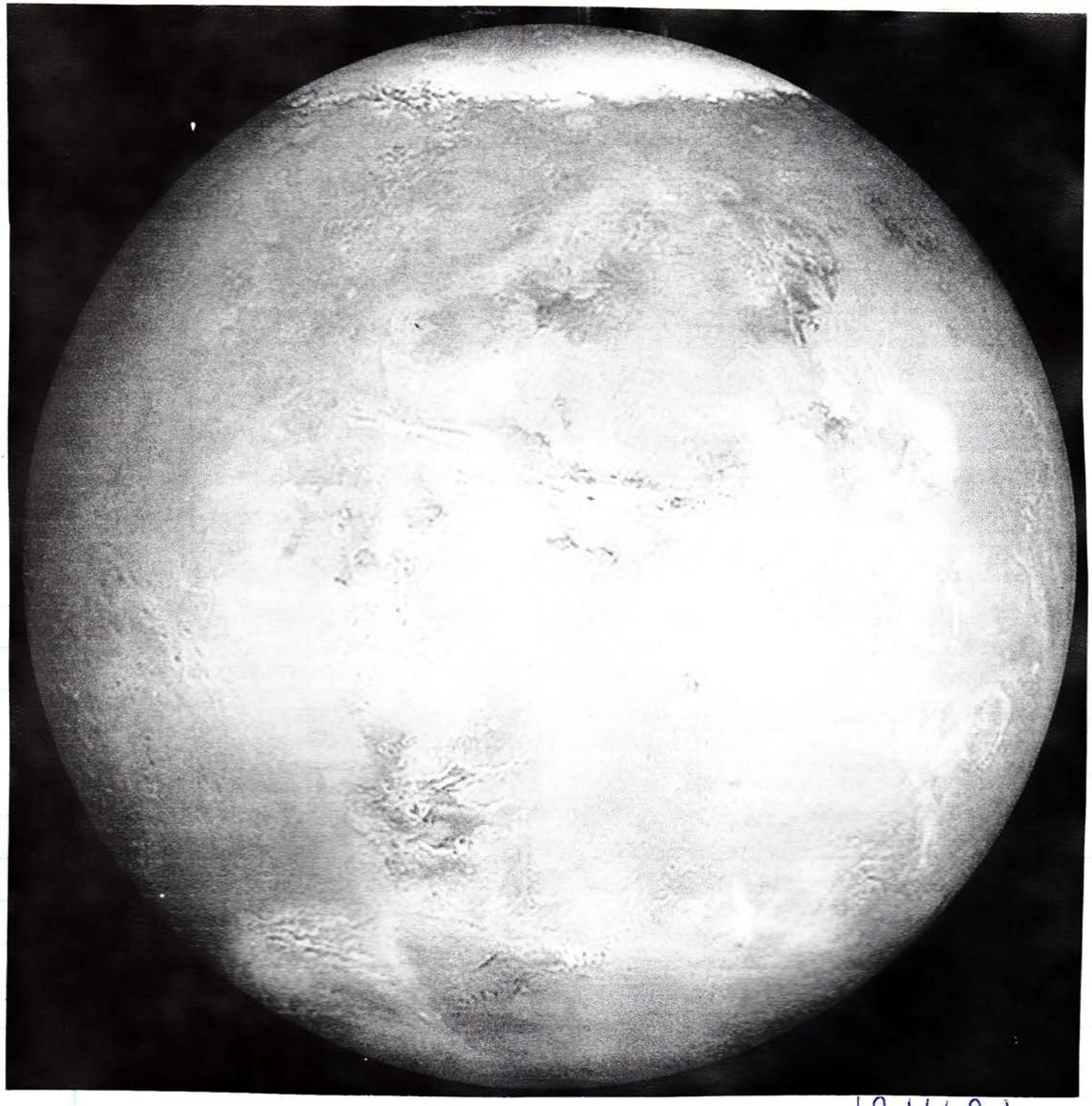

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HOUSTON CHRONICLE : 28 AUGUSTUS 2003.

DETAILS IN MARS PHOTOS AMAZE SCIENTISTS.

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BALTIMORE - The Hubble Space Telescope captured spectacular images of Mars during the planet's close pass by Earth, including astonishingly detailed pictures of a polar ice cap and a giant canyon wall. "We've never seen this kind of resolution in Hubble images, that kind of detail," said Cornell University astronomer Jim Bell on Wednesday, pointing to a wall of the Valles Marineris, a canyon that runs 2,800 miles across the Red Planet. The Baltimore-based Space Telescope Science Institute, which operates the telescope, released some of the Hubble images, made late Tuesday and early Wednesday as the planet made its closest pass by Earth in 60,000 years. The images, taken when Mars was about 34.6 million miles from Earth, show details as small as 17 miles across. In the first photo released, an ice cap covering Mars' south pole is clearly visible. Craters dot the orange and brown sphere, and hazy, bluish white surface clouds can be seen. "They are quite spectacular. You knew they were going to be good; seeing them is something else," said Michael Wolff, an astronomer with the Space Science Institute in Boulder, Colo. "These are the best that have ever been, and will ever be taken with the Hubble Space Telescope." Scientists will study the pictures in detail, and hope the images lead to discoveries. "Before we were looking at broad areas and things tend to get averaged out," Wolff said. "There's the possibility something we missed before will be there." Although spacecraft orbiting Mars can show objects in greater detail, they often cannot make an image of the entire planet at once, or at all times of the Martian day, Wolff said. Earthbound telescopes, meanwhile, have to deal with the distorting effects of the Earth's atmosphere. The Hubble also has instruments that allow it to capture wavelengths that spacecraft orbiting Mars cannot see.

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Mars op 55.758.006 kilometer van de aarde

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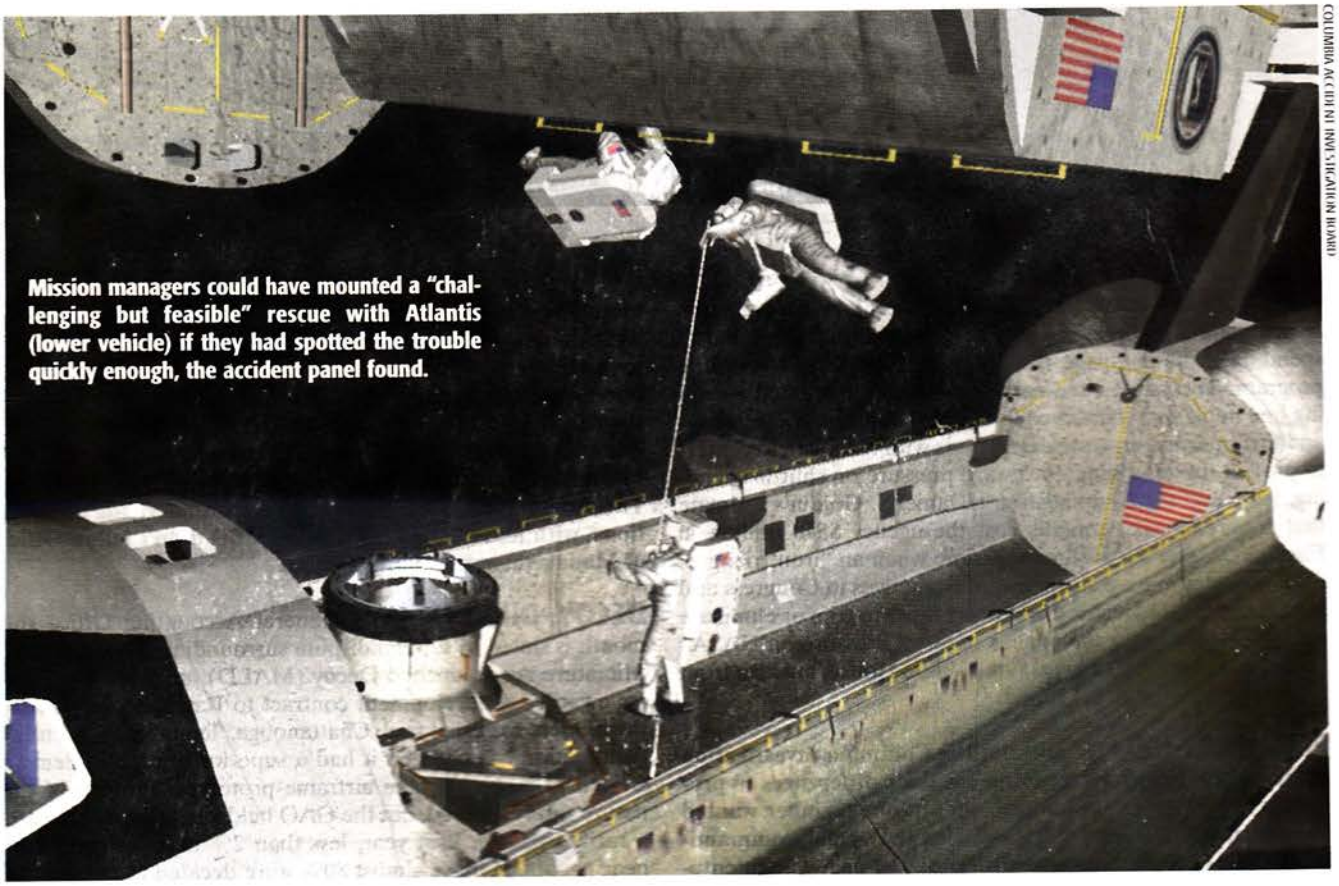

COLUMBIA ACCIDENT INVESTIGATION BOARD

Mission managers could have mounted a "challenging but feasible" rescue with Atlantis (lower vehicle) if they had spotted the trouble quickly enough, the accident panel found.

CULTURE SHO

NASA considers a test flight to validate fixes set by Columbia accident board; schedule pressure from ISS continues

FRANK MORRING, JR./WASHINGTON

A chastened NASA is shifting its preparations for relaunching the space shuttle fleet into high gear this week, guided by the Columbia Accident Investigation Board's unvarnished criticism of agency "culture" but still faced with exactly the same schedule pressures the CAIB said forced that culture into fatal mistakes.

Already on the table for reconsideration is the mission of the next shuttle flight, STS-114. Originally planned to carry supplies and a fresh crew to the International Space Station (ISS), it may be restructured as a test flight to validate orbiter inspection and repair techniques the CAIB directed NASA to develop before shuttle operations resume. NASA has been planning an early return to flight since March, driven largely by the need to support the station, but Administrator Sean O'Keefe has also vowed to comply fully with the CAIB recommendations before the shuttle flies again.

"We get it," he said of the report's criticisms. "We will go forward now and with great resolve to follow this blueprint and do our best to make this a much stronger organization."

As members of the "NASA family" digest the stinging charge that they forgot the painful lessons of the 1986 Challenger disaster, the station crew—and the station itself—still depend on a prompt return to flight of the remaining shuttles for their own safety and well-being. Last week, NASA was holding a target launch date in March 2004 for the shuttle Atlantis on STS-114 (*AW&ST* July 28, p. 32). But the CAIB found that pressure from the top to meet a political deadline on ISS assembly might have distracted the human spaceflight organization from its safety obligation to the Columbia crew, and CAIB members cautioned against haste as they released their final report on Aug. 26.

"I think that the entire tragedy here is a massive stop and rethink point, a turning point for NASA, as it says in the board statement, which I think that the whole schedule gets kind of zero-based at this point," said board member Steven B. Wallace, director of the FAA's Office of Accident Investigation.

That is just what NASA will do, according to William F. Readdy, who as

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associate administrator for space flight is responsible for the shuttle program. Readdy has been overseeing return-to-flight planning based on interim recommendations from the CAIB, and he said last week his staff was analyzing the board's report to ensure all its recommendations are included in the plan and to gauge the schedule impact.

"It's not date driven," Readdy said. "Let me be very, very clear. We're going to be milestone driven, and those milestones are going to be derived from the CAIB final report. They have been very explicit about return-to-flight items, and not only are we going to accept their findings, we're going to comply with their recommendations."

One of the most difficult recommendations had already been issued when the final CAIB report came out last week, and fulfilling it will almost certainly impact both the return-to-flight plan and the ISS assembly schedule that will follow from it. To give shuttle crews a better chance to survive the sort of thermal protection system (TPS) damage that brought down Columbia, the CAIB said NASA should develop ways to find and fix TPS breaches in orbit, something the Columbia crew was not equipped to do.

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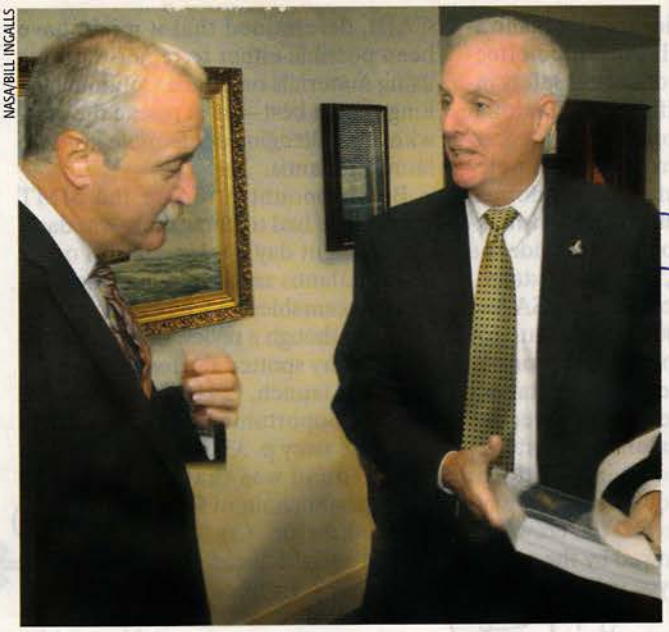
Agency engineers have already developed a sort of high-tech caulk gun attached to a strap-on spacesuit backpack where repair materials are mixed and ejected onto damaged ceramic tiles. Ground tests at Johnson Space Center in vacuum and an arc-jet facility designed to mimic reentry have been positive, Readdy said, and astronauts have started working out repair procedures in NASA's KC-135 low-gravity aircraft.

Repairing the reinforced carbon-carbon (RCC) panels that shield wing leading edges and other sensitive areas during reentry has proved more challenging, but a technique used by ATK Thiokol to repair RCC rocket motor nozzles is the leading contender. It combines a patch of RCC, backed by adhesive and held in place with "something like a moly bolt" used to hang pictures in drywall. Astronauts would apply the patch over damaged RCC, inject a glob of plugging material behind it, and leave the bolt head outside to burn off on reentry.



NASA/BILL INGALLS

Administrator O'Keefe (left) predicts "seminal" debate growing out of the report presented last week by accident board Chairman Gehman.

8/1/24

For inspecting an orbiter in flight, NASA engineers have proposed a robot arm extension patterned on one built to test plume effects from the shuttle reaction control system in proximity operations. Computer modeling has demonstrated that a camera on the end of the extension would be able to examine an orbiter's belly and leading edges, and it likely will become standard equipment on future flights.

To meet a CAIB recommendation that the tank and orbiter be photographed early in each mission to find any damage, "we will fly the next flight with a camera on the external tank looking at the orbiter, like we did on STS-112," Readdy said. "We will fly, certainly, with [orbiter] umbilical-well cameras, and we will develop the techniques to be able to do that near real time, so we can actually record that and then dump it to the ground."

Readdy conceded the extra weight of the new safety equipment would reduce the amount of cargo a shuttle can carry to the ISS. To compensate, controllers may allow the station's orbit to decay a little more so the orbiters won't have as much altitude to gain for a rendezvous.

Plans are already in the works to test the tile-repair techniques in Atlantis' cargo bay on STS-114, and other tests could also wind up on the manifest for that mission.

"We may just simply declare STS-114 as a return-to-flight developmental flight," Readdy said. "We haven't really decided. . . . We may drop down to a minimum amount of utilization cargo on board and just declare it a return-to-flight test."

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In that event, Atlantis may not deliver a replacement crew to ISS, and its station-supply load would be cut to allow more weight for test hardware. That—and the operational changes it would test—will in turn further stretch the time it will take to build ISS, and to meet other shuttle tasks like servicing the Hubble Space Telescope.

"All of those things are on the table," Readdy said. "We're going to be driven by the critical milestones necessary to return safely to flight."

After a six-and-a-half-month investigation, the CAIB's conclusion on the physical cause of the Columbia accident could be summed up in four words uttered by panel member G. Scott Hubbard, director of Ames Research Center—"the foam did it." A 1.67-lb. slab of insulating foam fell off the external tank 81.7 sec. after Columbia was launched Jan. 16 and hit the left wing leading edge at the point where the wing angled away from the fuselage. Sixteen days later, the resulting breach in the RCC panel designed to protect the aluminum wing from the heat of reentry allowed superheated gas into the wing, which melted in critical areas and failed as the descending orbiter hit denser air over Fort Worth and Dallas.

But the bureaucratic conditions that allowed the foam strike to occur and go undetected during the mission were "just as important as the foam," said Adm. (ret.) Harold W. Gehman, Jr., the CAIB chairman. The board devoted a lot of time to understanding those "organizational causes" of the accident, in addition to isolating the foam strike as the technical culprit.

"Cultural traits and organization practices detrimental to safety and reliability were allowed to develop, including: reliance on past success as a substitute for sound engineering practices (such as testing to understand why systems were not performing in accordance with

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requirements/specifications); organizational barriers which prevented effective communication of critical safety information and stifled professional differences of opinion; lack of integrated management across program elements, and the evolution of an informal chain of command and decision-making processes that operated outside the organization's rules," the panel stated.

Until the Feb. 1 accident, NASA had targeted Feb. 19, 2004, as the date for the "U.S. core complete" milestone in station assembly, meaning the Italian-built Node 2 would be in place to receive the European and Japanese laboratory modules. NASA and its international partners were already starting to plan how they would increase the crew size beyond the three allowed by the capacity of the Russian Soyuz vehicle used as the ISS lifeboat.

BUT TO HIT that target date, the CAIB found, NASA would have had to meet a launch schedule as tight as the one that led up to the Challenger disaster, which was cited by the commission that investigated that accident as contributing to it. In analyzing transcripts of the five mission management team (MMT) meetings held during Columbia's final mission, the CAIB suggested that the team and its chairperson, Linda Ham, may have been driven more by that schedule than by safety considerations. During the mission, Ham noted in an e-mail message that the formal "rationale" for launching Columbia against a backdrop of foam shedding on earlier missions—notably STS-112 in October 2002—was "lousy," but did not order a thorough analysis of potential damage of the foam strike on Columbia.

"Ham was due to serve, along with Wayne Hale, as the launch integration manager for the next mission, STS-114," the CAIB reported. "If the shuttle program's rationale to fly with foam loss was found to be flawed, STS-114, due to be launched in about a month, would have to be delayed per NASA rules that require serious problems to be resolved before the next flight. An STS-114 delay could in turn delay completion of the International Space Station's Node 2, which was a high-priority goal for NASA managers."

The CAIB also faulted Ham for not calling daily meetings of the MMT, as required by NASA spaceflight rules, and for assuming that there would be nothing that could be done if the foam strike had indeed caused serious damage to the TPS. After the accident, NASA engineers, working on the request of the CAIB, determined that it might have been possible either to repair the wing using materials on board Columbia—a long shot at best—or to rescue the crew with a "challenging but feasible" rush to launch Atlantis.

But to mount a rescue the MMT would have had to know there was damage by flight day 7—Jan. 22—in order to get Atlantis ready and launched before consumables on Columbia ran out. But even though a review of launch camera imagery spotted the foam strike the day after launch, CAIB counted eight "missed opportunities" to get another look (see story p. 33). One problem the board found was that no one in the operational chain of command for Columbia's flight "held a security clearance that would enable them to understand the capabilities and limitations of national imagery resources," secret satellites and telescopes that might have detected the damage.

RCC repair combines patch (black) with adhesive (gray), held against damaged panel (green) with a moly bolt (green stripes).

Nor was there anyone outside the chain of command with the independence necessary to pick up the threat that the line managers were missing. The CAIB found that NASA's associate administrator for safety and mission assurance—former astronaut Bryan O'Connor—"is not responsible for safety and mission assurance execution . . . but is responsible for safety and mission assurance policy, advice, coordination and budgets." Similarly, the panel found that the safety organizations that support the shuttle program also depend on it for funding, "which hampers their status as independent advisers" (see story p. 27).

In setting out recommendations to be followed before return to flight, as well as longer term institutional reforms (see story p. 26), the CAIB called for "an independent technical engineering authority that is responsible for technical requirements and all waivers to them" in the shuttle program. Based on the board's review of U.S. Navy safety practices that NASA was already studying at the direction of O'Keefe, the recommendation would appear to fall under the purview of the new NASA Engineering and Safety Center to be set up Oct. 1 at Langley Research Center in Hampton, Va. (*AW&ST* Aug. 25, p. 28).

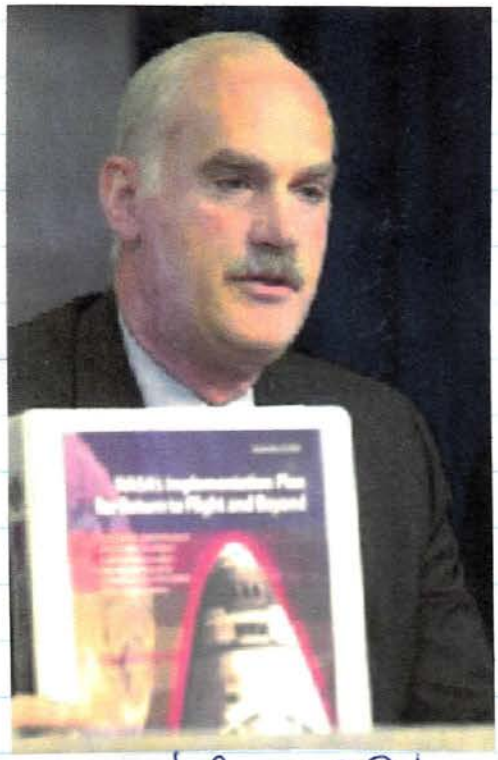
However, O'Keefe said last week it remained to be seen whether the Langley organization, which is intended to serve all NASA programs, or a special organization for the shuttle program, would be chartered to meet the recommendation. O'Connor visited Langley last week to work on the new organization's charter in light of the CAIB report. He established his personal independence under former Administrator Daniel S. Goldin when he resigned as head of the shuttle program at NASA headquarters rather than accept a program reorganization he (and, later, the CAIB) found objectionable.

Release of the CAIB report sets the stage for a national debate O'Keefe described as "seminal" on the future of the U.S. space program. Congress will begin hearings this week that are likely to last through the fall, as it tries to sort out how to proceed with expensive near-term upgrades and set long-term goals in the face of unprecedented federal budget deficits.

"In many ways, the report should serve as a wake-up call for NASA to return to the fundamentals of designing, building, operating, maintaining and monitoring highly complex technical systems," stated Sen. John McCain (R-Ariz.), chairman of the Senate Commerce, Science and Transportation Committee, in announcing a shuttle hearing Sept. 16. "Congress' task will be not only to ensure that the CAIB's recommendations are implemented in both the short term before the space shuttle returns to flight and the long term before flaws in NASA's culture are perpetuated, but also to define the goals of the human space flight program."

For his part, O'Keefe declined to speculate publicly on how the space program will fare in the coming debate, or to estimate what it will cost to meet the CAIB recommendations.

"As a member of this administration, we certainly are going to be valuing and evaluating those particular consequences in the context of what is necessary to proceed forward with compliance with these recommendations and what resource requirements we'll have," he said. "And certainly that debate will continue and will go on inside the administration as well as within the Congress. And so, the results of that will be known in due time."



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FLORIDA TODAY : 03 SEPTEMBER 2003.

SENATORS RIP NASA DURING DISASTER PROBE. FIRST DAY OF HEARING YIELDS NO BLAME-TAKER.

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WASHINGTON - NASA Administrator Sean O'Keefe dodged attempts by senators Wednesday to pin blame for the Feb. 1 shuttle Columbia disaster on individual managers at the space agency. Sen. Ernest Hollings, D-S.C., pressed O'Keefe to explain why two key shuttle managers -- Linda Ham and Ralph Roe -- were not disciplined or fired for their roles in the 16-day mission that ended with the deaths of seven astronauts. "I'm trying to fix responsibility," Hollings said at the first congressional hearing on the disaster since the Columbia Accident Investigation Board released its report last week. The House Science Committee will begin hearings Thursday. O'Keefe explained some former managers are no longer at NASA or have been transferred to jobs outside the shuttle program. But Hollings, sounding indignant, reminded O'Keefe that Roe, formerly manager of shuttle engineering at Johnson Space Center in Houston, was appointed second in command at a new engineering and safety office at Langley Research Center in Hampton, Va., after the Columbia accident. That doesn't indicate to me you got it," Hollings told O'Keefe. "You take the man who failed at safety and he's No. 2 at the safety office." Members of the accident investigation board did not blame either Ham or Roe for the Columbia accident, but their report did note flaws in the Columbia management team's decision-making process. They also noted managers missed several opportunities to get satellite photographs of the shuttle in orbit. That might have revealed the damage inflicted by a chunk of insulation foam that broke off the external fuel tank and hit the shuttle's left wing. In defending Roe's appointment to the new safety center, O'Keefe paraphrased legendary rocket builder Wernher von Braun: "When you make a mistake, you become that much more valuable." Lawmakers peppered O'Keefe and retired Adm. Harold Gehman Jr., chairman of the investigation board, with questions about some of the most troubling aspects of the panel's 248-page report. O'Keefe offered promises but few details on precisely what NASA will do to recover from the disaster and from investigators' conclusion that the agency allowed its once-potent system of checks and balances to atrophy. Sen. Bill Nelson, D-Tallahassee, pressed the NASA chief to estimate the cost and time it would take to make the hardware and management changes directed by Gehman's board before the remaining three shuttles could fly again. O'Keefe acknowledged NASA and White House officials are discussing a range of spending plans but refused to offer details. Several senators agreed with the investigative board's finding that the space agency no longer has a recognizable goal and has been weakened by years of inadequate funding. Knowing how much it will cost to make the shuttle safe to fly again is crucial, said Sen. Sam Brownback, R-Kan. Lawmakers want to assess whether it is cost effective to carry on with the shuttles or retire them and spend the money on a replacement. Are we throwing good money after bad?" Brownback asked. "We may be at the point to say 'scuttle the shuttle.' " Gehman said his board's most important recommendation was to create an engineering and safety office that would function independently of the shuttle program operation. The office would set and control the technical specifications for shuttle operations. It also would control NASA's waiver process, which accident investigators said had grown lax. Separating the engineers from the operations managers would insulate safety decisions from launch pressures and budget constraints, Gehman said. Simply creating an organization that sits on the sideline and kibitzes and second guesses is not good enough," Gehman said. NASA has yet to specify how it would go about creating such an office, which Gehman said would involve a staff of at least 200 engineers. That would represent a substantial cost not currently in NASA's spending plans. O'Keefe said NASA is studying the recommendation and will respond to it.

Columbia Board's Recommendations

The Columbia Accident Investigation Board made the following recommendations, and NASA Administrator Sean O'Keefe pledged that the agency would implement them all. The highlighted portions must be in place before the shuttle can return to flight.

THERMAL PROTECTION SYSTEM

Initiate an aggressive program to eliminate all external tank thermal protection system debris shedding at the source, with particular emphasis on the region where the bipod struts attach to the external tank.

Initiate a program designed to increase the orbiter's ability to sustain minor debris damage by measures such as improved impact-resistant reinforced carbon-carbon and acreage tiles. This program should determine the actual impact resistance of current materials and the effect of likely debris strikes.

Develop and implement a comprehensive inspection plan to determine the structural integrity of all reinforced carbon-carbon system components. This inspection plan should take advantage of advanced non-destructive inspection technology.

For missions to the International Space Station, develop a practicable capability to inspect and effect emergency repairs to the widest possible range of damage to the thermal protection system, including both tile and reinforced carbon-carbon, taking advantage of the additional capabilities available when near to or docked at the International Space Station.

For non-station missions, develop a comprehensive autonomous (independent of the station) inspection and repair capability to cover the widest possible range of damage scenarios.

Accomplish an on-orbit thermal protection system inspection, using appropriate assets and capabilities, early in all missions.

The ultimate objective should be a fully autonomous capability for all missions to address the possibility that an International Space Station mission fails to achieve the correct orbit, fails to dock successfully, or is damaged during or after undocking.

To the extent possible, increase the orbiter's ability to successfully reenter Earth's atmosphere with minor leading-edge structural subsystem damage.

In order to understand the true material characteristics of reinforced carbon-carbon components, develop a comprehensive database of flown reinforced carbon-carbon material characteristics by destructive testing and evaluation.

CAIB said repairing Columbia with materials on board would have been "high risk."

Improve the maintenance of launch pad structures to minimize the leaching of zinc primer onto reinforced carbon-carbon components.

Obtain sufficient spare reinforced carbon-carbon panel assemblies and associated support components to ensure that decisions on reinforced carbon-carbon maintenance are made on the basis of component specifications, free of external pressures relating to schedules, costs or other considerations.

Develop, validate and maintain physics-based computer models to evaluate thermal protection system damage from debris impacts. These tools should provide realistic and timely estimates of any impact damage from possible debris from any source that may ultimately impact the orbiter. Establish impact damage thresholds that trigger responsive corrective action, such as on-orbit inspection and repair, when indicated.

IMAGING

Upgrade the imaging system to be capable of providing a minimum of three useful views of the space shuttle from liftoff to at least solid rocket booster separation, along any expected ascent azimuth. The operational status of these assets should be included in the launch commit criteria for future launches. Consider using ships or aircraft to provide additional views of the shuttle during ascent.

Provide a capability to obtain and downlink high-resolution images of the external tank after it separates.

Provide a capability to obtain and downlink high-resolution images of the underside of the orbiter wing leading edge and forward section of both wings' thermal protection system.

Modify the memorandum of agreement with the National Imagery and Mapping Agency to make the imaging of each shuttle flight while on orbit a standard requirement.

ORBITER SENSOR DATA

The modular auxiliary data system instrumentation and sensor suite on each orbiter should be maintained and updated to include current sensor and data acquisition technologies.

The modular auxiliary data system should be redesigned to include engineering performance and vehicle health information, and have the ability to be reconfigured during flight in order to allow certain data to be recorded, telemetered, or both as needs change.

WIRING

As part of the shuttle-service-life-extension program and potential 40-year service life, develop a state-of-the-art means to inspect all orbiter wiring, including that which is inaccessible.

BOLT CATCHERS

Test and qualify [new] flight hardware bolt catchers [for the massive bolts that hold the solid rocket boosters to the shuttle stack].

CLOSEOUTS

Require that at least two employees

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attend all final closeouts and inter-tank area hand-spraying procedures.

MICROMETEOROID AND ORBITAL DEBRIS

Require the space shuttle to be operated with the same degree of safety for micrometeoroid and orbital debris as the degree of safety calculated for the International Space Station. Change the micrometeoroid and orbital debris safety criteria from guidelines to requirements.

FOREIGN OBJECT DEBRIS

Kennedy Space Center quality assurance [officials] and United Space Alliance must return to the straightforward, industry-standard definition of foreign object debris and eliminate any alternate or statistically deceptive definitions like "processing debris."

SCHEDULING

Adopt and maintain a shuttle flight schedule that is consistent with available resources. Although schedule deadlines are an important management tool, those deadlines must be regularly evaluated to ensure that any additional risk incurred to meet the schedule is recognized, understood and acceptable.

TRAINING

Implement an expanded training program in which the mission management team faces potential crew and vehicle safety contingencies beyond launch and ascent. These contingencies should involve potential loss of shuttle or crew, contain numerous uncertainties and unknowns, and require the mission management team to assemble and interact with support organizations across NASA/contractor lines and in various locations.

ORGANIZATION

Establish an independent technical engineering authority that is responsible for technical requirements and all waivers to them, and will build a disciplined, systematic approach to identifying, analyzing and controlling hazards throughout the life-cycle of the shuttle system. The independent technical authority does the following: develop and maintain technical standards for all space shuttle program projects and elements; act as the sole waiver-granting authority for all technical standards; conduct trend and risk analysis at the subsystem, system and enterprise levels; own the failure mode, effects analysis and hazard reporting systems; conduct integrated hazard analysis; decide what is and is not an anomalous event; independently verify launch readiness; approve provisions of the recertification program.

The technical engineering authority should be funded directly from NASA headquarters, and should have no connection to or responsibility for schedule or program cost.

NASA headquarters office of safety and mission assurance should have direct line authority over the entire space shuttle program safety organization and should be independently resourced.

Reorganize the space shuttle integration office to make it capable of integrating all elements of the space shuttle program, including the orbiter.

Prepare a detailed plan for defining, establishing, transitioning and implementing an independent technical engineering authority, independent safety program and a reorganized space shuttle integration office [as described above]. In addition, NASA should submit annual reports to Congress, as part of the budget review process, on its implementation activities.

RECERTIFICATION

Prior to operating the shuttle beyond 2010, develop and conduct a vehicle recertification at the material, component, subsystem and system levels. Recertification requirements should be included in the service-life extension program.

CLOSEOUT PHOTOS/ DRAWING SYSTEM

Develop an interim program of closeout photographs for all critical subsystems that differ from engineering drawings. Digitize the closeout photograph system so that images are immediately available for on-orbit troubleshooting.

Provide adequate resources for a long-term program to upgrade the shuttle engineering drawing system including: reviewing drawings for accuracy, converting all drawings to a computer-aided drafting system and incorporating engineering changes.

Failure an Option?

NASA's shallow safety program put Columbia and her crew on same path as Challenger

CRAIG COVAULT/KENNEDY SPACE CENTER

NASA must undertake sweeping internal changes to prevent a third space shuttle accident and to correct a seriously flawed safety oversight culture that has led to the death of 14 astronauts and the loss of the orbiters Columbia and Challenger, the Columbia Accident Investigation Board (CAIB) said in its sobering final report.

"TWICE IN NASA'S HISTORY, the agency embarked on a slippery slope that resulted in catastrophe. Each decision, taken by itself, seemed correct, routine, and indeed, insignificant and unremarkable. Yet in retrospect, the cumulative effect was stunning," the board reported.

Board Chairman Adm. (ret.) Harold W. Gehman, Jr., said that the loss of Columbia on reentry Feb. 1 was not so much a random event, but more the predictable end of a multiyear saga that evolved as NASA's safety program grew impotent and entangled with management issues.

"The board's investigation shows that for all its cutting-edge technologies, 'diving-catch' rescues and imaginative plans for the technology and the future of space exploration—NASA has shown very little understanding of the inner workings of its own organization," the report stated.

The board went on: "NASA's blind spot is that it believes it has a strong safety culture. But program history shows that the loss of a truly independent, robust capability to protect the system's fundamental requirements and specifications inevitably compromised those requirements and, therefore, increased risk.

"The Shuttle Program's structure created power distributions that need new structuring, rules and management training to restore deference to technical experts, empower engineers to get resources they need and allow safety concerns to be freely aired," the board said.

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"NASA's safety culture has become reactive, complacent and dominated by unjustified optimism," it said. "Over time . . . independent checks and balances intended to increase safety have been eroded in favor of detailed processes that produce massive amounts of data and unwarranted consensus, but little effective communication."

THE 13-MEMBER PANEL and its 120-member staff conducted more than 100 closed-door interviews and numerous open hearings while overseeing dozens of tests and computer analysis. It proved that during launch Jan. 14, a large piece of Lockheed Martin external tank bipod foam ruptured Columbia's left wing, resulting in the reentry deaths of astronauts USAF Col. Rick Husband, Navy Cdr. William McCool, Kalpana Chawla, USAF Lt. Col. Michael Anderson, Navy Capts. Laurel Clark and David Brown and Israel Air Force Col. Ilan Ramon.

The board also exposed how NASA digressed from previous safety-related process on the separation of external tank bipod foam, allowing Columbia to fly—when a similar incident on STS-112, two flights earlier, had raised initial concern.

In a revealing e-mail sent during Columbia's flight, veteran flight director Linda J. Ham, chairperson of the Mission Management Team (MMT), commented to shuttle program manager Ronald Dittemore that the "Rationale was lousy then and still is," relative to the external tank being safe to fly with no added risk, in light of the large bipod separation on the STS-112 flight.

In another noteworthy comment, the board characterized a NASA headquarters effort to downplay the significance of a bipod separation on STS-112—three months before the accident—as a "sleight-of-hand effort" to make the probability of bipod foam loss appear low, rather than grappling with a problem that proved fatal a few weeks later.

"There is clearly still evidence of 'a silent safety program' with echoes of Challenger," in the board findings, said USAF Maj. Gen. John L. Barry, CAIB executive director and the head of plans and programs for Air Force Materiel Command.

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A "silent safety program" was a key reason for the Challenger accident, the 1986 Rogers Commission found.

Again in Columbia "NASA had conflicting goals of cost, schedule and safety and unfortunately safety lost out," Barry said. "What we went through in our analysis is trying to figure out how we can fix 'the culture.'"

At NASA there is a lack of safety program independence and a lack of integrated safety functions. "But more importantly, a lack of integration within the shuttle program itself," Barry said.

Aviation Week & Space Technology specifically raised shuttle "safety culture" and "safety reform" concerns four months prior to the Columbia accident in the article "Shuttle Shakeup Eyed for Cost and Safety Goals" (*AW&ST* Sept. 23, 2002, p. 33).

Another *AW&ST* article raised concerns by astronauts and managers about safety in the wake of early privatization (*AW&ST* Dec. 24, 2001, p. 36). Those moves gave many of NASA's safety and mission-assurance responsibilities to United Space Alliance—shifting NASA away from oversight.

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Computational fluid dynamics analysis used aerodynamic and mass properties of bipod foam, coupled with complex shuttle flow field data, to model the likely position and velocity of the foam as it tumbled toward impact with leading edge.

"We believe that was a mistake and that there needs to be stronger technical oversight by government employees," said Columbia board member John Logsdon of George Washington University. Many Johnson managers at the time were arguing for more privatization believing it would improve safety by retaining engineering talent.

The board, including former astronaut Sally K. Ride, who served on the Rogers Commission as well, are especially troubled about the commonality between the Challenger and Columbia accidents.

"The echoes of Challenger in Columbia have serious implications," the board said. "These repeating patterns mean that flawed practices embedded in NASA's organizational system continued for 20 years and made substantial contributions to both accidents.

"NASA managers believed that the agency had a strong safety culture, but the board found that the agency had the same conflicting goals it did before Challenger, when schedule concerns, production pressure, cost-cutting and a drive for ever-greater efficiency—all the signs of an "operational" (versus actually developmental) enterprise had eroded NASA's ability to assure mission safety.

"The belief in [this] safety culture has even less credibility in light of repeated cuts of safety personnel and budgets, also conditions that existed before Challenger," according to the board.

"NASA managers stated confidently that everyone was encouraged to speak up about safety issues and that the agency was responsive to those concerns, but the Board found evidence to the contrary—in responses to the Columbia Debris Assessment Team's request for imagery, to the initiation of the imagery request from Kennedy Space Center—and to the 'we were just what-iffing' e-mail concerns that did not reach the MMT.

"NASA's bureaucratic structure kept important information from reaching engineers and managers alike," the board said.

AND THE BOARD FOUND that during Columbia's flight, critical top managers were playing by a different set of rules than working-level engineers.

"The board found that MMT decision-making operated outside the rules even as it held its engineers to a stifling protocol.

"Management was not able to recognize that in unprecedented conditions, when lives are on the line, flexibility and democratic process should take priority over bureaucratic response.

"NASA's philosophy for safety and mission assurance calls for centralized policy and oversight at headquarters and decentralized execution of safety programs at the program and project levels.

"Headquarters dictates what must be

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FLORIDA TODAY : 05 SEPTEMBER 2003.

NASA DETAILS PLAN TO RETURN SHUTTLES TO FLIGHT. NIGHT LAUNCHES OUT / FLIGHT DATE REMAINS UNCERTAIN.

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CAPE CANAVERAL - NASA said it will suspend night launches and institute new checks and balances over contractors and its own managers before returning the shuttle fleet to space. Astronauts already are testing ways to repair a damaged heat shield in space, and the first redesigned fuel tank, without the piece of foam implicated in the Columbia accident, is to be delivered to Florida by year's end. Less than two weeks after investigators demanded sweeping reforms, NASA officials on Friday privately outlined for members of Congress a detailed plan and schedule for fixing the ills that doomed Columbia. The "implementation plan," obtained by Florida Today, indicates NASA is on track to fulfill most of the Columbia Accident Investigation Board's recommendations in time to launch again in March if all goes as planned. However, the plan also shows the agency may need more time with some of the broader organizational changes. "They're back-pedaling on the launch date," said David Goldston, chief of staff for the House Science Committee who sat in on one of Friday's private briefings. "They are now describing the March date as a no earlier than date. If that's really hard to complain about that." The return to flight plan, to be released publicly Monday, says NASA will: Launch space shuttles only during daylight hours until it installs a new high-tech camera system capable of detecting in-flight debris and resulting damage in the dark. Consider changing re-entry flight paths and landing sites, if necessary, to reduce the risk of shuttle debris damaging property or killing people on the ground. Redesign the insulation coating the external fuel tank to reduce the amount of foam breaking free from the tank and slamming into the orbiter in the minutes after liftoff. The agency also will toughen the wing panels and heat-shielding tiles where possible to increase resistance to debris hits. Give shuttle astronauts ways to inspect and repair a crippled heat shield in space and, in cases when that doesn't work, have a plan for the shuttle crew to survive on the space station for up to six months awaiting rescue. Beef up training for mission managers so they learn how to better deal with emergencies in flight. Set a launch schedule that can be safely achieved with the aging shuttles and within NASA's budget. NASA will give its engineers the power to increase government oversight of contractors' work. The agency's document included no budget figures. "We will continue to refine our plans and, in parallel, we will identify the budget required to implement them," the return to flight document said. Many ongoing tests need to be finished before NASA can choose options, and that will determine the price tag. Goldston said Congress is anxious for figures, but understands the dilemma. Hearings scheduled next week, and throughout the fall, will focus sharply on the proposed changes NASA is recommending and whether they meet the spirit and the letter of the report issued by the Columbia board, he said. "We'll plow through this document and see. NASA would be the first to acknowledge that, even at 150 pages, this leaves a lot of unanswered questions," Goldston said. Michael Kostelnik, NASA's Deputy Associate Administrator for the shuttle and International Space Station programs, briefed key members of the Senate and the House on the plan. It will be posted on NASA's main Web site Monday. "We wanted to brief Congress (before the public release) as a courtesy to them," said Al Feinberg, a spokesman for NASA Headquarters in Washington. The document says NASA also plans to revamp its safety organization, including creating a new safety and engineering center at Langley Research Center that will be independent from the shuttle program. The agency, in its document and briefing, agreed that does not meet the full intent of the board's recommendation for an independent engineering body that would review a wide range of decisions made by shuttle managers. The program is reviewing all "waivers" of shuttle safety requirements. Florida Today reported earlier this year that there were more than 1,600 waivers of known problems with shuttle systems that could lead to catastrophe at the time Columbia launched. Investigators found that was excessive and suggested an independent engineering review of such waivers. NASA's plan says that review is under way now and "waivers will be retained only if the controls and engineering analysis associated with the risks is revalidated. This review will be completed prior to return to flight."

done, not how it should be done. The operational premise that logically follows is that safety is the responsibility of program and project managers.

"Managers are subsequently given flexibility to organize safety efforts as they see fit, while NASA headquarters is charged with maintaining oversight through independent surveillance and assessment. NASA policy dictates that safety programs should be placed high enough in the organization, and be vested with enough authority and seniority, to 'maintain independence.'"

But, the board said, "in reality, such a process demands a more independent status than NASA has ever been willing to give its safety organizations."

This set the stage for events critical to Columbia's last flight—events that actually began with the STS-112 flight of Atlantis where a large chunk of bipod foam separated from the external tank during a launch several weeks before Columbia's. It harmlessly scuffed a solid rocket booster skirt, but should have sent a clear warning of catastrophic risk.

That should have been recognized in the program requirements control board meeting for the following STS-113 flight. According to the accident board, this event at the STS-113 flight readiness review is among those most directly linked to the STS-107 accident.

"Had the foam loss during STS-112 been classified as a more serious threat, managers might have responded differently when they heard about the foam strike on STS-107. Alternately, in the face of the increased risk, STS-107 might not have flown at all.

"However, at STS-113's flight readiness review, managers formally accepted a flight rationale that stated it was safe to fly with foam losses. This decision enabled, and perhaps even encouraged, [MMT] members to use similar reasoning when evaluating whether the foam strike on STS-107 posed a safety-of-flight issue."

At the program requirements control board meeting following the return of STS-112, the NASA intercenter photo working group recommended that the loss of bipod foam be classified as an In-Flight Anomaly—a much more critical designation.

But, the board said, the program requirements control board ultimately decided against such classification in a meeting chaired by Dittemore and attended by many of the managers who would be actively involved with STS-107, including Ham.

"Instead, the program requirements control board assigned an 'action' to the external tank project to determine the root cause of the STS-112 foam loss and to propose corrective action."

The board found this was inconsistent with previous practice, in which all other known bipod foam-shedding was designated as In-Flight Anomalies.

The program requirements control board initially set Dec. 5, 2002, as the date to report back on this action, even though STS-113 was to launch on Nov. 10. The due date subsequently slipped until after the planned launch and return of STS-107, the board said.

Consequently the space shuttle program decided to fly *two* missions before resolving the STS-112 foam loss.

"The board wondered why NASA would treat the STS-112 foam loss differently than all others. What drove managers to reject the recommendation that the foam loss be deemed an In-Flight Anomaly? Why did they take the unprecedented step of scheduling not one, but eventually two missions to fly before the external tank project was to report back on foam losses?"

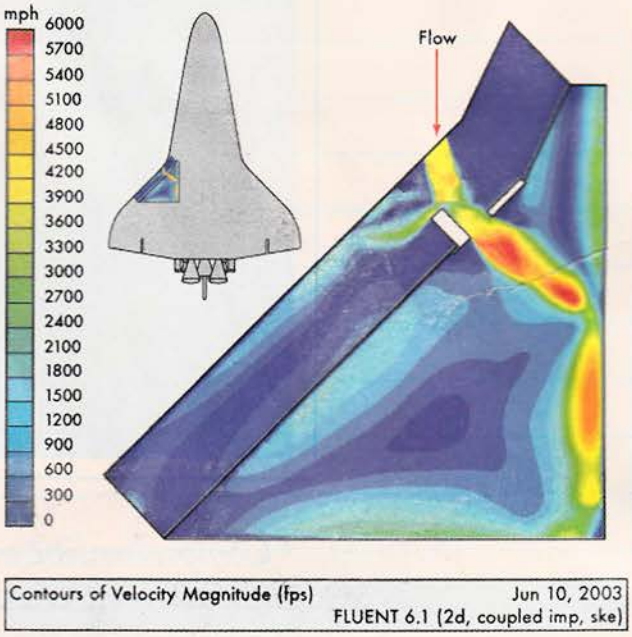
It seems that shuttle managers had become conditioned not to regard foam loss or debris as a safety-of-flight concern, the board said.

OTHER FACTORS WERE emerging. Had STS-113—preceding Columbia—been delayed beyond early December 2002, the Expedition 5 crew on board the International Space Station would have exceeded its 180-day on-orbit limit, and the Node 2 launch date, a major management goal, would not be met.

With no engineering analysis, shuttle managers used past success as a justification for future flights, and made no change to the external tank configurations planned for STS-113, and, subsequently, for STS-107.

"The acceptance of the rationale to fly cleared the way for Columbia's launch and provided a method for Mission managers to classify the STS-107 foam strike as a 'maintenance and turnaround concern' rather than a safety-of-flight issue.

The board noted: "It is significant that in retrospect, several NASA managers identified their acceptance of this flight rationale as a serious error." The die was cast for Columbia's mission. The board also noted, "Linda Ham would later characterize that reasoning as 'lousy.'"



Computational analysis shows top of left wing and belly schematic where 4,000-mph. superheated air (yellow) penetrated then flowed through wing, at points compressed to 6,000 mph. (red), pushing temperatures to over 5,000F in a structure that melts at 2,500F.

Columbia launched on Jan. 14 without incident. The discovery of the foam strike in post-launch photography has been well documented, as has the difficulty safety managers had obtaining detail from the imagery.

The board made the following points about the safety and management decision processes during STS-107:

- Flawed Analysis: An inexperienced team, using a mathematical tool (Crater software) not designed to assess an impact of this estimated size, performed the analysis of the potential effect of the debris impact.

"At the Jan. 24, MMT meeting at which the 'no safety-of-flight' conclusion was presented, there was little engineering discussion about assumptions made, and how results would differ if other assumptions were used."

- Low Management Concern: "Program managers, from Ron Dittemore to

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individual MMT members, had, over the course of the Space Shuttle Program, gradually become inured to external tank foam losses and, on a fundamental level, did not believe foam striking the vehicle posed a critical threat to the Orbiter. In particular, shuttle managers exhibited a belief that RCC panels are impervious to foam impacts.

"The opinions of shuttle program managers and debris and photo analysts on the potential severity of the debris strike diverged early in the mission and continued to diverge as the mission progressed, making it increasingly difficult for the debris assessment team to have their concerns heard by those in a decision-making capacity."

In the face of mission managers' low level of concern and desire to get on with the mission, debris assessment team members had to prove unequivocally that a safety-of-flight issue existed before shuttle program management would move to obtain images of the left wing. The engineers found themselves in the unusual position of having to prove that the situation was unsafe—a reversal of the usual requirement to prove that a situation is safe.

"AND A TILE EXPERT told managers during frequent consultations that strike damage was only a maintenance-level concern and that on-orbit imaging of potential wing damage was not necessary. Mission management welcomed this opinion and sought no others."

- Hierarchy: The board observed an unofficial hierarchy among NASA programs and directorates that hindered the flow of communications. "Team members opined that by raising contrary points of view about shuttle mission safety, they would be singled out for possible ridicule by their peers and managers."
- Lack of Clear Communication: "Communication did not flow effectively [to or] from program managers. As it became clear during the mission that some managers were not as concerned as others about the danger of the foam strike, the ability of engineers to challenge those beliefs greatly diminished.

"Managers did not seem to understand that as leaders they had a corresponding and perhaps greater obligation to create viable routes for the engineering community to express their views and receive information."

- Lack of Effective Leadership: "The shuttle program and MMT were not actively directing the efforts of the debris assessment team. These teams were not engaged in scenario selection or discussions of assumptions and did not actively seek status, inputs, or even preliminary results from the individuals charged with analyzing the debris strike" the board said. "Managers claims that they didn't hear the engineers' concerns were due in part to their not asking or listening."
- Fundamental Failure of Safety: "Safety personnel were present but passive and did not serve as a channel for the voicing of concerns or dissenting views. Safety representatives attended meetings of the debris assessment team, mission evaluation room, and MMT, but were merely party to the analysis process and conclusions instead of an independent source of questions and challenges.

"Safety contractors in the Mission Evaluation Room were only marginally aware of the debris strike analysis. One contractor did question the debris assessment team safety representative about the analysis and was told that it was adequate. No additional inquiries were made," the board said.

It was under these circumstances that Columbia, the first winged reusable manned spacecraft, initially launched in 1981, was lost along with her crew on her 28th mission on the 113th flight of the space shuttle program—a mission during which "some space shuttle program managers failed to fulfill their implicit contract to do whatever is possible to ensure the safety of the crew," the Gehman board concluded.

Crew Module Separated

KENNEDY SPACE CENTER

The shuttle orbiter crew cabin carrying its seven astronauts separated from the main body of the orbiter during breakup and may have retained pressure integrity for as long as 80 sec. after the last transmission from the crew, according to data in the accident board report.

Although the board did not specifically say so, new breakup details allow for perhaps 60-90 sec. of crew awareness that Columbia was going out of control.

From a separation standpoint, this is somewhat similar to how the crew module of Challenger separated and fell free during its 1986 accident. Although in Columbia's case, thermal degradation from high temperatures resulted in the structural separation as opposed to structural loads alone in the case of Challenger.

Data indicate the last transmission and telemetry were received in Mission Control at 8:59:32 a.m. EST. The orbiter digressed from aerodynamic flight into a ballistic descent at 9:00:01 a.m. The orbiter experiments (MADS) recorder continued to be powered electrically taking internal data until 9:00:19, about 1 sec. before the start of main body breakup. The crew was still alive sometime after this point, the board indicated.

A cabin breach was predicted at about 9:00:50 a.m., the board found.

"The Armed Forces Institute of Pathology and the FBI conducted forensic analyses on the remains of the crew of Columbia. It was determined that the acceleration levels the crew module experienced prior to its catastrophic failure were not lethal. The death of crewmembers was due to blunt force trauma and hypoxia.

"The exact time of death—sometime after 9:00:19 a.m.—cannot be determined because of a lack of direct physical or recorded evidence," the board reported.

"It appears the destruction of the crew module took place over a period of 24 sec. beginning at an altitude of approximately 140,000 ft. and ending at 105,000 ft.," according to the board.

The initial burn-through of the left wing spar had occurred about 8 min. earlier at about 238,000 ft., still off the coast of California. Approximately 40-50% of the crew module was recovered in central Texas, the board said.

"The forensic evaluation of all recovered crew module/forward fuselage components did not show any evidence of over-pressurization or explosion. The failure of the crew module resulted from the thermal degradation of structural properties, which resulted in a rapid sequential structural breakdown rather than an instantaneous 'explosive' failure," the board said.

Separation of the crew module/forward fuselage assembly from the rest of the orbiter likely occurred directly in front of the payload bay. "Subsequent breakup of the assembly was a result of ballistic heating and dynamic loading," the board said.

"Such knowledge is critical to efforts to improve crew survivability when designing new vehicles and identifying feasible improvements to existing orbiters."

Roller Coaster

Columbia board found budget, workforce 'turmoil' in the run-up to the accident

FRANK MORRING, JR./WASHINGTON

The shuttle Columbia's reentry breakup on Feb. 1 came at the end of a decade of turbulence in the U.S. human spaceflight program that played a leading part in creating the conditions that led to the disaster, the Columbia Accident Investigation Board suggested in its report.

Ever-downward pressures on shuttle spending intersected with expansion of its service life, even as the demands of building the International Space Station (ISS) drew on a dwindling engineering pool at the space agency. When combined with the reorganizations and shifting management techniques imposed by then-Administrator Daniel S. Goldin, the shuttle program lost sight of some of the difficult lessons it had learned in the wake of the January 1986 Challenger disaster, board members found.

"In order to fund other parts of the NASA program, the shuttle program was squeezed during the '90s," said board member John M. Logsdon, director of the Space Policy Institute at The George Washington University. "The budget was cut by 40%. The workforce was cut by 40%. That left too little margin for robust operation of the system in our judgment. It was operating too close to too many margins."

The problem's roots date back to the 1970s, the board found, when spending on NASA dipped from almost 4% of the federal budget at the height of the Cold War Apollo Moon project to about 1%, where it has remained ever since. As early as 1990, when NASA faced lengthy shuttle groundings and a manufacturing flaw in the main mirror of the Hubble Space Telescope, a panel headed by Lockheed Martin's Norman Augustine found the agency "over-committed in terms of program obligations relative to resources available."

The Augustine commission priced "a reinvigorated space program" at about $30 billion a year in 1990 dollars—roughly twice the actual levels Congress appropriated as the Clinton administration "reinvented" government.

"During the past decade, neither the White House nor Congress has been interested in a 'reinvigorated space program,'" the board wrote. "Instead, the goal has been a program that would continue to produce valuable scientific and symbolic payoffs for the nation without a need for increased budgets."

One product of that mindset was the International Space Station, which began eating into the shuttle budget under a White House edict that ISS overruns come out of the overall human spaceflight account (see chart). As the trend gathered steam, in 1994 Congress canceled the Advanced Solid Rocket Motor, an expensive shuttle upgrade.

"Given the high priority assigned after 1993 to completing the costly International Space Station, NASA managers have had little choice but to attempt to reduce the costs of operating the space shuttle," the board report stated. "This left little funding for shuttle improvements."

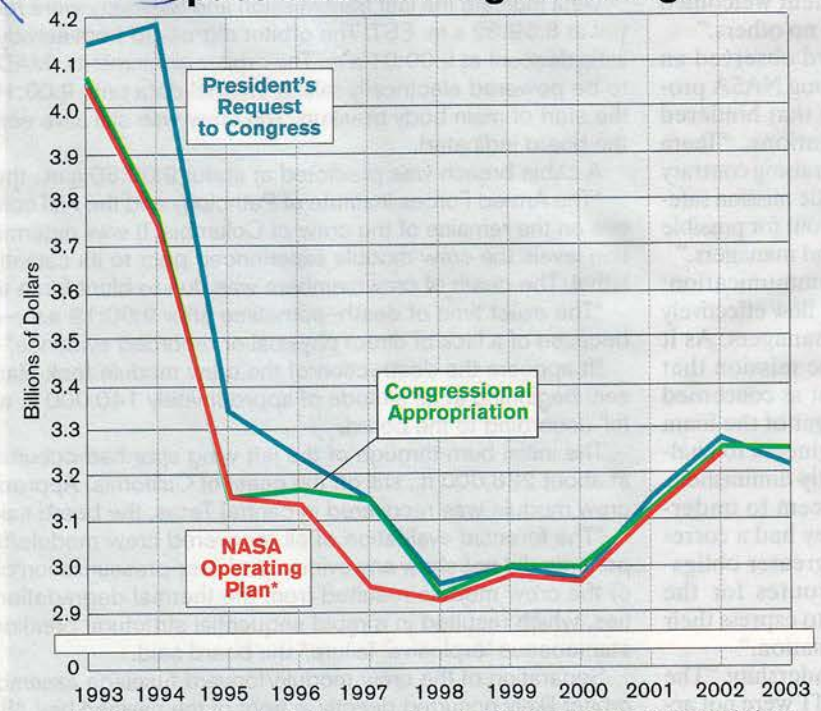
GOLDIN TOOK ON the task of shoehorning the shuttle and ISS into a flat budget and, the board noted, "his tenure at NASA was one of continuous turmoil, to which the space shuttle program was not immune." Similarly, the board found that George W.S. Abbey, a close Goldin associate named director of Johnson Space Center in 1996, "was a powerful leader, who through the rest of the decade exerted substantial control over all aspects of Johnson Space Center operations, including the space shuttle program."

The board quoted Goldin as saying in 1994 warnings that budget cuts would impact shuttle safety were "a bunch of crap." But in a formal finding, the board disagreed.

"Throughout its history, NASA has consistently struggled to achieve viable safety programs and adjust them to the constraints and vagaries of changing budgets," the board stated. "Yet, according to multiple high level independent reviews, NASA's safety system has fallen short of the mark."

One source of those shortcomings was the "uncertainty and tension within the shuttle workforce" that came with the cutbacks Goldin ordered to trim costs, the board said. By the end of the '90s Goldin, under strong pressure from top human spaceflight managers like Kennedy

Space Shuttle Program Budget



*NASA's operating plan is the means for adjusting congressional appropriations among various activities during the fiscal year as changing circumstances dictate. These changes must be approved by NASA's appropriation subcommittees before they can be put into effect.

Source: NASA Office of Space Flight

Space Center Director Roy Bridges, reversed the cuts and began increasing shuttle staffing again. But over the decade between 1993 and 2002, the "standing army" needed to fly the shuttle dwindled to 17,462 civil servants and 15,744 contractor employees from 30,091 and 26,310, respectively.

Many of those cuts were achieved by consolidating most of the 86 different space shuttle contracts under a single "Space Flight Operations Contract," a move recommended in 1995 by a panel headed by Johnson Space Center veteran Chris Kraft. The Kraft panel based its recommendation in part on the conclusion that the shuttle had become "a mature and reliable system . . . about as safe as today's technology will provide." The board took strong issue with that conclusion, and found it led to engineering and safety shortcuts that would not have been taken had the shuttle been operated as an experimental vehicle.

"Based on believing that the shuttle was a mature system, NASA turned a lot of its operations over to a single contractor," Logsdon said. "But importantly, it turned a lot of NASA responsibilities in safety and mission assurance over to that contractor and backed off, did insight rather than oversight of the program. And we believe that was a mistake and that there needs to be stronger technical oversight by civil servants, by government employees of the program."

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Missed Chances

CRAIG COVAULT/KENNEDY SPACE CENTER

The Columbia accident board found that a lack of effective leadership and clear-cut communications coupled with inaction on the part of designated safety oversight personnel resulted in eight specific "missed opportunites" during the flight to find or characterize suspected wing damage.

Had any one or two of these missed opportunities turned out differently, the wing damage might have been found, possibly leading to consideration of a rescue attempt by the orbiter Atlantis undergoing launch processing at Kennedy. The opportunities involved discussion of reconnaissance satellite imaging as well as crew inspection options. They included:

- Flight Day 4. Rodney Rocha, NASA's designated chief engineer for thermal protection systems, asked Johnson Space Center's Engineering Directorate if the crew had been asked to inspect for damage. No response.
- Flight Day 6. Mission Control failed to ask STS-107 crew member David Brown to downlink additional video he took of external tank separation.
- Flight Day 6. NASA and National Imagery and Mapping Agency personnel discussed possible request for imagery. No action taken.
- Flight Day 7. Wayne Hale, shuttle program manager for launch integration at Kennedy, phoned a Defense Dept. representative, who in turn began identifying military imaging assets, only to be stopped per Mission Management Team leader Linda Ham's orders.
- Flight Day 7. Michael Card, a NASA headquarters manager from the Safety and Mission Assurance Office, discussed imagery request with Mark Erminger of Johnson Space Center Safety and Mission Assurance Office. No action taken.
- Flight Day 7. Card discussed imagery request with former astronaut Bryan O'Connor, associate administrator for safety and mission assurance. No action taken.
- Flight Day 8. Barbara Conte, Mission Operations Directorate representative, after discussing imagery request with Rodney Rocha, called LeRoy Cain, the STS-107 ascent/entry flight director. Cain checked with Phil Engelauf, the flight's Mission Operations representative and then delivered a "no" answer.
- Flight Day 14. Card discussed the imaging request with former astronaut William Readdy, associate administrator for space flight. Readdy directed that imagery should only be gathered on a "not-to-interfere" basis. None was forthcoming.

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NASA can do it—again

As the dust settles following release of the long-awaited—and blistering—report of the Columbia Accident Investigation Board, it's time for a little perspective.

The board, under the extremely able leadership of retired Adm. Harold W. Gehman, Jr., has done NASA and the U.S. a major service by looking beyond the nuts and bolts to the real reasons the space shuttle Columbia broke apart over Texas. It wasn't just the foam, Gehman and his talented colleagues found. It was a human spaceflight organization grown sclerotic and complacent, unwilling to look for trouble that threatened a tight, politically driven launch schedule. The good ole boys—and girls—thought they knew more than they did. Deviance, in sociologist Diane Vaughn's memorable phrase, had become normalized, and the result was fatal to the seven brave crewmembers on the doomed orbiter.

NASA has been here before, of course. Vaughn was commenting on the missed signals that led to the 1986 Challenger disaster, yet somehow her lesson was lost. There is plenty of blame to go around, and the Gehman report is unstinting in delivering it. The report is ugly reading, as Administrator Sean O'Keefe warned it would be. NASA employees from O'Keefe down to the greenest agency engineer should find it a helpful guide as they inventory the values and attitudes they bring to their highly risky business. Nor should the politicians outside the agency who set U.S. space policy consider themselves off the hook. Congress and several presidential administrations of both parties created the political environment in which the shuttle operated, and it was just as ferocious and unforgiving as the one that penetrated Columbia's thermal protection system on its last reentry.

But assigning blame and holding individuals accountable through firings and reassignments doesn't really fix the problem, one that is not unique to NASA. As the future of the U.S. space program is debated in the weeks ahead, it would be helpful to remember that NASA hasn't been the only "high-reliability organization" to have missed danger signals from its hardware. Think of Europe's Concorde operation, which treated tire failures and debris strikes on the supersonic transport's wings as maintenance issues until they sent one of the beautiful airplanes and its passengers into a hotel near Paris Charles de Gaulle airport.

And while it is hard to believe the lessons learned after Challenger were forgotten, the fact remains that NASA's human spaceflight organization did recover from that accident and flew without serious mishap for almost 15 years. Along the way it took the lead role in designing, building and assembling the International Space Station, an unprecedented technical and political accomplishment.

The Gehman panel noted that NASA never got over its Apollo-era image as a "perfect place," as "the best organization that human beings could create to accomplish selected goals," even as its place in the world changed with the Moon landings and the end of the Cold War. But that heritage includes the horror of the Apollo 1 fire and NASA's spectacular recovery from it.

It took more than technical skill and a sharp organization for NASA to bounce back from Apollo 1 with the Apollo 8 and 10 circumlunar flights, the Apollo 11 landing, the other five landings and the dramatic rescue of Apollo 13. It took more than skillful politicians and clever public relations to save Skylab after its rough launch, and then to go on and design, build and fly something as elegantly capable as the space shuttle. It took desire and guts, a love of knowledge and exploration, and the "can-do" spirit that is essential if NASA is to recover from this latest setback and continue satisfying the human urge to explore—in person—that drove Columbia's Husband, McCool, Anderson, Brown, Chawla, Clark and Ramon.

The Gehman board has given NASA a manual for recovery. It wisely draws on "best practices" from a number of high-reliability organizations that operate dangerous equipment safely, year after year. Notable among them is the U.S. nuclear Navy, which was already sharing its safety "benchmarks" with NASA when Columbia went down. O'Keefe, a former Navy secretary, deserves credit for pushing that initiative, and we hope he will follow through. He has agreed to all of the panel's recommendations, including one that NASA set up an independent technical engineering authority—patterned on naval practice—for the shuttle that would separate safety from operations, and keep the aging vehicle on the ground when it isn't safe to fly.

O'Keefe says there is a realization at the top working level of the space program that culture change at NASA must be institutionalized to ensure that it endures beyond the next round of retirements. We hope he is right. Certainly there is an opportunity here to set some needed reforms in stone, and they should go beyond the shuttle-specific recommendations of the accident investigation board.

Release of the report clears the way for the White House to issue its long-stalled presidential space transportation policy, and staffers there would do well to read carefully the report's history of the political compromises that produced the shuttle design in the first place. Similarly, the Gehman panel offers some helpful suggestions on a replacement for the shuttle that stress the need for substantial technical improvements and a willingness to pay for them.

The space shuttle will fly again. There are plenty of astronauts at NASA who are fearless and skilled enough to take Atlantis and her sister ships back to orbit, just as there are plenty of NASA engineers with the expertise to meet and surpass the Gehman board's recommendations, and plenty of managers with the talent to fix NASA culture. But the long-term future of human spaceflight will be shaped by the ability of all concerned to get back in touch with the legacy of excellence that has sustained NASA through its past triumphs —and disasters.

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HOUSTON CHRONICLE : 06 SEPTEMBER 2003.

NASA PLANS TO HAVE SHUTTLES UP AND FLYING AGAIN NEXT YEAR.

WASHINGTON - NASA has developed an ambitious plan to get space shuttles flying again next year that details the steps the agency is taking to comply with each recommendation of the board that investigated the Columbia accident. The Implementation Plan for Return to Flight and Beyond, to be released on Monday, outlines numerous changes in launching procedures and training, as well as the National Aeronautics and Space Administration's plans for modifying space shuttles to make them safer. Among other actions, NASA is looking at ways to harden the shuttle to protect it from debris, is developing a repair material that can be used in space on heat tiles and other parts of the shuttle, and plans to improve training for mission managers. On Aug. 26, the Columbia Accident Investigation Board released a 248-page report that was highly critical of the NASA operations and decision-making that led up to the Feb. 1 shuttle disaster. The 13-member board, led by Harold W. Gehman Jr., a retired admiral, made 29 recommendations for reforming the shuttle program and NASA, including 15 it required be put in place before shuttle flights resume. The plan, a copy of which was provided to The New York Times, is a broad blueprint listing actions the agency is pursuing to fulfill those requirements. The agency has also outlined actions it is taking beyond the recommendations, including evaluating the International Space Station as a haven for shuttle crews that might be stranded because of a problem. NASA calls its plan a living document that will be continually updated as it works to comply with the Gehman board recommendations. The return-to-flight plan includes a schedule for completing scores of tests, modifications and procedural reforms aimed at having the shuttle Atlantis resume flights in April 2004. At a hearing last Thursday on the Gehman report, the chairman of the House Science Committee, Sherwood L. Boehlert, a New York Republican, said he was worried that NASA was moving too quickly to resume flights, without completing necessary reforms. "I'm concerned that NASA may already be rushing to meet unrealistic launch dates instead of examining this report closely and moving deliberately," Boehlert said. He said that it was time to re-examine human space flight and the shuttle program, and that Congress would play a role in deciding when the shuttle flew again. The NASA administrator, Sean O'Keefe, told a Senate hearing on Wednesday that there was no rush to meet a spring deadline. O'Keefe said flights would resume only when all work was completed and a task force of outside experts assembled by NASA had signed off on the changes. "It will occur when we determine we are fit to fly," he said. The plan was in the works even before the Gehman board released its final report. As the board was conducting its investigations, it released five recommendations early so that NASA could get to work on them. These included using better imaging of shuttles at takeoff and in space to detect potential problems, developing tools to repair damaged heat protection shuttle components in space, and eliminating the shedding of insulating foam from the main fuel tank during launching. Investigators determined that Columbia had been irreparably damaged when a piece of foam struck its left wing shortly after takeoff and cracked heat-protection material on the leading edge. When the shuttle returned from a 16-day mission, superhot gases penetrated the wing, causing structural failure that doomed Columbia and its seven-member crew. NASA's plan for resuming flights will be assessed by its independent Return to Flight Task Group, led by two former astronauts, Thomas P. Stafford and Richard O. Covey, which is to meet in Houston this week to consider it. According to the plan, NASA is examining eight near-term options for hardening the shuttle against damage caused by minor debris, as recommended by the investigation board. The agency also is continuing impact tests on the reinforced carbon-carbon protective material that was breached on Columbia's wing in order to build computer models that accurately predict impact damage. Engineers are looking at five methods for conducting a nondestructive test of the carbon material while it is in place on the vehicle. NASA also is developing a silicone-based, heat-resistant material that can be applied in space and adheres to heat tiles, aluminum and other shuttle materials. The material, which cures in a vacuum, has been shown in tests to resist the thousands of degrees of heat experienced during re-entry, the document said. The agency will also add a suite of cameras on the shuttle to examine the fuel tank and rocket boosters that separate from the orbiter during launch, as well as cameras to view the underside of the ship. Insulating foam will no longer be used in an area where the fuel tank attaches to the shuttle, the source of the debris that struck Columbia. These attachment points will now be warmed by heaters to prevent ice formation there. The agency said it was reorganizing the management team that supervises shuttle missions in flight to improve communications, the chain of command and the ability to assess risks. After the Columbia accident, this team was criticized for not being accessible to concerns expressed by lower-level engineers about possible launching damage to the shuttle. This team will now undergo expanded training, including drills on handling safety contingencies. NASA also has developed a program to take detailed pictures of all critical systems inside and outside the shuttle as it is being readied for launching, so that they are available for in-orbit troubleshooting. In addition, engineers are upgrading orbiter engineering drawings to reflect modifications over the years and converting them to computerized drafting system for quick reference. Separate from the recommendations, NASA said it was re-evaluating risks to the public from shuttle launching, reentries and landings, particularly the potential danger to people and property under flight paths to its three primary landing sites. Part of this study will look at alternative flight paths.

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YAHOO NEWS : 08 SEPTEMBER 2003.

NASA WANTS TO RESTART SHUTTLE FLIGHTS IN EARLY 2004.

WASHINGTON – NASA said Monday it wants to resume shuttle flights as early as March 11 next year, barely 13 months after the Columbia disaster which brought the programme to a halt. Much criticised by the official inquiry into the breakup of Columbia, which killed all seven astronauts on board, the National Aeronautics and Space Administration said it was determined to correct the mistakes as quickly as possible. A 156-page document released by the US space agency said it wanted to send Atlantis to the International Space Station orbiting the Earth. The plan mentions a launch window between March 11 and April 6 "for planning purposes only, that's our first available milestone. It's not we must, we are going to or we have to," said Doc Mireslon, a NASA spokesman in Washington. Bill Readdy, NASA associate administrator for space flights, said "as we make progress towards the critical milestones (for a return to flight) and solve technical issues that will emerge, we will converge on a viable return to flight day, whether that turns out to be March, April, May, June or July, so be it. "We will be safety driven and not schedule driven." The flight resumption plans were released less than two weeks after the Columbia Accident Inquiry Board slammed NASA's management "culture" for contributing to the shuttle disaster on February 1. The board listed 29 changes to safety and management that had to be carried out. In its response, NASA said it will "pursue an in-depth assessment to identify and define areas where we can improve our culture and take aggressive corrective action." Following revelations that engineers had warned about the loose piece of foam that fatally damaged Columbia's wing on take-off, NASA said the improvements would include changes in communications between managerial levels. NASA shuttle chiefs said the engineers' warning had never reached them. One of the technical priorities will be replacing the isolation foam around the external tank. A piece of that foam broke off during the January 16 launch of Columbia and hit the underside of the left wing creating a breach "that allowed super-heated air to enter and destroy the wing structure during entry." NASA will install electric heaters to prevent ice formation around the shuttle tanks. It said cameras will be installed to monitor for damage during take-off and other surveillance equipment, including US spy satellites orbiting the Earth, will be used to watch for shuttle problems. All launches will be carried out during daylight hours, NASA added, to improve safety monitoring. But this will reduce the number of "launch windows" for the shuttle. Cameras will also be put on the International Space Station and its robot arm to inspect for damage to the shuttle. The accident board also ordered that astronauts should be able to carry out space walks to carry out repairs when necessary. NASA said it is "developing materials and procedures for repairing Thermal Protection System tiles and reinforced carbon-carbon panels in flight." The agency said it was not yet able to estimate the cost of all the extra work to be carried out but promised to lay out its "budgetary needs". After the destruction of Columbia and the 1986 explosion of Challenger after takeoff, NASA has the Atlantis, Endeavour and Discovery shuttles left.

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CNN : 08 SEPTEMBER 2003.

NASA PLAN TARGETS MARCH FOR SHUTTLE RETURN.

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WASHINGTON - NASA has developed a "return to flight" plan for future shuttle missions -- one that aims for a resumption of flights as early as next March. The 78-page report offers a look at the steps the space agency has been taking, or is considering, in order to comply with recommendations by the Columbia Accident Investigation Board. Columbia's seven astronauts were killed February 1 when the shuttle broke apart as it re-entered the atmosphere from space. The NASA plan, being released officially Monday, lists a return to a flight schedule with a March 11 "launch date," but agency spokesman Allard Beutel said the date is simply a planning date and not a foregone conclusion. Beutel said officials are looking at a March-to-April launch window, but that could easily slip if the agency isn't able to meet all of its targeted safety steps. The report, obtained by The Associated Press on Sunday, makes no mention of cost estimates for the return to flight. For nine of the 15 return-to-flight requirements outlined by the investigative board, the National Aeronautics and Space Administration makes only pledges or discusses plans to comply. For these items, the plan talks of "potential solutions," "assessing options" or says "procedures are under evaluation," indicating that final plans are still evolving. An example is the board's requirement that NASA find a way to "harden" the thermal protection system, making it more resistant to impact from debris. In its response, NASA says it has selected "eight near-term options" for further study and made no final decision. The agency had specific plans to fix a basic hardware element linked to the loss of Columbia. The spacecraft was fatally damaged during launch when a chunk of foam insulation that covered a strut attach point on the external tank peeled off and shattered a thermal protection panel in the left wing. The insulation was required to prevent the formation of ice when the tank is filled with supercold liquid oxygen and hydrogen. To avoid this problem, NASA said heaters will be incorporated at the attach point to eliminate the need for foam insulation. But other efforts to lessen foam insulation peeling from other parts of the external tank remain under study, the agency said. The investigative board also said NASA must develop a way for spacewalking astronauts in orbit to view the leading edge of the shuttle wings and the craft's underside. And it called on the agency to develop ways of repairing, in orbit, thermal protection tiles or panels broken during launch. NASA said only that efforts are "under development." Among other steps outlined in the agency's plan:

• Officials will add cameras in various locations on the shuttle to get a better idea of any possible damage. For the next launch, a camera is being added to the external fuel tank to view the so-called bipod area, where the foam came off during Columbia's launch.

• NASA has struck an agreement with the National Imagery and Mapping Agency and other facilities to provide spy satellite camera images of the orbiter during flight. Members of an independent advisory group will assess and evaluate NASA's progress on implementing the Columbia accident board's recommendations. The task force will be led by veteran astronauts Thomas Stafford and Richard Covey.

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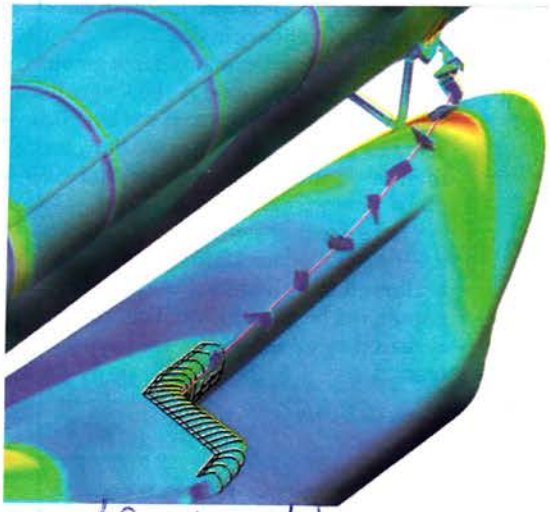

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Vision Thing

Capitol Hill begins to digest Columbia report as White House debates U.S. future in space

FRANK MORRING, JR./WASHINGTON

Top Bush administration officials are engaged in what NASA Administrator Sean O'Keefe described as "fulsome debate" over the future of the U.S. space program, while senators and congressmen on Capitol Hill geared up last week for a season of hearings on the Columbia accident with calls for a clear vision of just what the U.S. wants to do in space.

O'Keefe told the Senate Commerce, Science and Transportation Committee that the White House would announce new goals for space as soon as President Bush has decided what they will be. Meanwhile, an interagency review was getting underway that O'Keefe said would use the NASA Strategic Plan's "stepping-stones" approach of gradually expanding human activity beyond Earth orbit as a starting point for the presidential decision-making.

Also on the table as a point of departure, O'Keefe said, is the Integrated Space Transportation Plan that shaped Bush's amended Fiscal 2003 NASA budget (*AW&ST* Nov. 11, 2002, p. 26). Included in those internal—and closely held—discussions are the budget requirements, which are eagerly awaited on Capitol Hill.

O'Keefe hinted that the administration would present an amended or supplemental budget request to accelerate spending for the proposed Orbital Space Plane (OSP)—a shift he has said privately could involve as much as $1.7 billion. But the NASA chief was circumspect in predicting the outcome of the interagency review.

"It will happen in the time it will happen," he said during a Sept. 2 press conference.

FOR THEIR PART, some members of NASA's authorizing committees seemed willing to accept that Congress too has played a role in creating the budget-starved NASA "culture" that the accident board blamed for the Feb. 1 loss of the shuttle Columbia.

"[The report] must serve as a wake-up call to NASA and to the nation that we have for too long put off hard choices, and forced the space program to limp along without adequate guidance or funding," said John McCain (R-Ariz.), the Senate commerce committee chairman. "... We will have to figure out where we want the space program to go, and what we expect to get out of it. Then, we will have to ensure that adequate and unearmarked funds are provided."

Adm. (ret.) Harold W. Gehman, Jr., chairman of the Columbia Accident Investigation Board, told the Senate panel that earmarks—appropriations language mandating the targeted spending sometimes referred to as "pork"—have added to the budget crunch at NASA by reducing management flexibility to apply money where it's needed. In the case of the shuttle program, he said after the hearing, it's clear more money is needed.

"That's not the same thing as saying NASA has to have more money," Gehman said. "NASA gets $15 billion, more or less, and whether or not that's enough for NASA is a public policy decision that Congress is going to have to make. But within that, the shuttle program is going to have to have money to take care of these problems."

While there was agreement in the Senate committee and its counterpart NASA authorizing panel, the House Science Committee, that Congress should fund human spaceflight adequately, some key House members called for the sort of vision statement that O'Keefe and the Bush administration have avoided delivering so far.

"I, for one, am not willing to write NASA a blank check for the shuttle program," said Rep. Sherwood Boehlert (R-N.Y.), chairman of the House science panel and an O'Keefe ally in the past. ". . . We need to better define NASA's overarching human spaceflight vision, something that has been lacking for more than a generation."

Rep. Dana Rohrabacher (R-Calif.), who chairs the science subcommittee with direct NASA oversight, echoed

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Boehlert in complaining about "a lack of strategic vision and a lack of broader national goals" in the space program.

"For the past 30 years NASA may well have been on the wrong path with the space shuttle," said Rohrabacher, who has used his chairmanship in the past to push for a shuttle replacement. "The shuttle has failed miserably to meet its original goals. Our reliance on such a complex and high-risk technology has drained billions of dollars from our treasury and other space programs, and has regrettably cost too many lives."

Sen. Kay Bailey Hutchison (R-Tex.) argued that the accident board's report demonstrated that the faster-better-cheaper policy pushed by former Administrator Daniel S. Goldin "should be thrown in the wastebasket," while Sam Brownback (R-Kan.), chairman of the NASA authorizing subcommittee in the Senate, called for a presidential commission on the future of space exploration. O'Keefe said he didn't know how that idea would play at the White House, but he promised to "do my best" to meet a request from Sen. Ron Wyden (D-Ore.) that NASA present a cost/benefit analysis on human spaceflight within six months.

NASA was scheduled to brief Congress on its near-term shuttle return-to-flight plan late last week, and to release the plan to the public at 9 a.m. Monday, Sept. 8. Agency managers started work on the plan in March, based on interim recommendations and public testimony of the board, and O'Keefe said the published accident report did not require any major changes in the document. It will include such operational details as daylight launches for better photography of any damage an orbiter might suffer on ascent, as well as details of inspection and repair techniques to find and fix such damage in orbit (*AW&ST* Sept. 1, p. 22).

O'Keefe said the plan will include some "TBDs"—matters to be determined—and will be subject to review and updating by an advisory task force headed by former astronauts Tom Stafford and Richard Covey. Gehman agreed on behalf of his 13-member group with a tentative request from Boehlert to reconvene in a year's time to review NASA compliance with the recommendations it forwarded.

NASA will seek any extra spending it requires expeditiously, O'Keefe told the Senate panel, stressing later that the planners were not subject to the sort of budget pressure the board blamed in part for the Columbia accident.

"It is not being driven by any budget exercise," he said. "The result of how much it's going to cost is going to be a tally, arithmetically, of each of the options selected and how much they cost, and that's when we'll know the answer to that."

As for personal accountability in the wake of the accident, O'Keefe noted that he has replaced the line managers and field center directors responsible for the shuttle program with his own choices, and strongly suggested there will not be any further reorganization. As for O'Keefe's own accountability, while the administrator took full personal responsibility for the accident because "it happened on my watch," Gehman let him off the hook.

"Every management trait, every communications problem, every engineering problem that we complain about as important was set in motion between five and 15 years ago, so it didn't happen on his watch," Gehman said.

Accident board Chairman Harold W. Gehman, Jr., shows a Senate panel the insulating foam section his group blamed for the Feb. 1 disaster. NASA Administrator Sean O'Keefe is at left.

UPI/AIR WORLD

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STIFF COMPETITION **Fixing the space shuttle program isn't going to be cheap, and the need to do so comes at a particularly difficult time for the Bush administration. With the occupation and reconstruction of Iraq estimated to reach $60-70 billion, and deficits hitting record levels even before that estimate was made, money for space exploration isn't exactly growing on trees. Retired Adm. Harold W. Gehman, Jr., who headed the accident investigation, said his panel believes NASA will have to hire hundreds of new engineers to fly the three surviving shuttles safely, or to recertify the aging vehicle as recommended if NASA wants to keep flying it beyond 2010. The return-to-flight implementation plan due out this week won't have much in the way of cost estimates in it, congressional expectations to the contrary notwithstanding (see p. 40). Hard-pressed White House budgeteers simply haven't figured out how much money will be available for human spaceflight, or NASA as a whole. Administrator Sean O'Keefe is likely to get hammered on that point this week when he testifies on the return-to-flight plan before the House Science Committee.**

AWST: 08-09-2003

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SPACE.COM : 08 SEPTEMBER 2003

SMARTER, STRONGER, SAFER
NASA TARGETS MARCH-APRIL 2004 LAUNCH.

CAPE CANAVERAL - "Smarter, stronger, safer" is NASA's new mantra, according to an introductory statement in the space agency's Return to Flight Implementation Plan released Monday. The 156-page plan is NASA's formal, public response to the Columbia Accident Investigation Board (CAIB) final report released Aug. 26. "Today as we publicly rollout out our Return to Flight Implementation Plan, we are taking that first step on what undoubtedly will be a tough, uphill climb to safely returning the space shuttle to flight status," said Bill Readdy, NASA's spaceflight chief in Washington. Point-by-point, the NASA plan addresses each of the CAIB's 29 findings and recommendations that will allow the space agency to resume flying space shuttles. Fixes both technical and cultural are described in detail. The plan leaves open the issue of how much extra money the changes to NASA and shuttle hardware will cost. "(The plan did not) attempt to capture implementation costs, per se. It was way too preliminary in order to incorporate that, but at some future date it shall," Readdy said. The plan's timeline continues to suggest March 11, 2004 as a target launch date for the next shuttle mission. However, many details have yet to be finalized before an actual date is selected, officials said. "When all that comes together in the next few weeks we will have a much better feel for when the launch date will be," said shuttle program manager Bill Parsons. Based on new guidelines for launching during the day, and considering when it's possible to launch to the International Space Station, Readdy said that available launch periods run roughly from March 11 to April 6, May 19 to June 28, July 18 to Aug. 26 and so on in that same general pattern. On the technical side the plan is very specific in offering steps to reduce the risk of flying the shuttle, most of which have been discussed in public before. For example, the bipod foam ramp that was the source of the insulation debris that fell from Columbia's external tank and struck the orbiter's left wing will be replace by a heater. Another change detailed in the plan is the desire to launch future shuttle missions during the day so that tracking cameras can better document any shedding foam from the tank. Once the foam problem is solved, NASA suggests that night launches might resume. And like the CAIB report, NASA's response does not directly address whether changes to the shuttle will be made to accommodate some kind of more robust crew escape system, such as an ejectable pod. But some of the more interesting changes in work have to do with NASA's plans to change its culture. Among them: Encouraging people to express dissenting views on technical matters, even if they do not have hard supporting evidence to back them up. In the past, engineers with a strong "gut" feeling something was wrong were ignored or silenced by superiors because there was no data to support the assertion. Require the Mission Management Team (MMT) to meet daily during missions as its own charter requires -- something they had not been doing -- and exercise the MMT during mission training simulations that will include crisis situations. In the past the MMT was not part of Mission Control training before a flight. Include independent and outside consultants to help train NASA management in decision making skills. Among the classes NASA managers might have to take: a US Navy course on the Challenger launch decision. Experts in these areas have been ignored by NASA managers in the past, according to the CAIB. Officials describe the NASA plan as a "living document" that may be refined as time goes on depending on input received from future volumes of the CAIB report. Congressional oversight committees or the White House. NASA plans to return to Capital Hill with an updated and revised plan in about a month. In the meantime, congressional hearings continue this week with the House Science Committee calling CAIB chairman, retired U.S. Navy Adm. Harold Gehman, to return and answer more questions about NASA and its return to flight plans. Gehman is scheduled to appear before the committee along with NASA Administrator Sean O'Keefe. It will be O'Keefe's first appearance before the House Science Committee since the CAIB released its final report. By the end of September, the House Science Committee expects to fall into a rhythm of weekly NASA hearings, each one focusing on a different aspect of the report. Also watching NASA through this process will be the Stafford Covey Task Group, an independent team of experts led by Project Gemini and Apollo astronaut Tom Stafford and veteran shuttle commander Dick Covey. The next shuttle will not launch without their blessing that NASA has met all of the CAIB's return to flight requirements. The task group is expected to meet in Houston this week and is scheduled to host a news briefing on Thursday. "All great journeys begin with a single step. With this initial implementation plan, we are beginning a new phase in our return to flight effort," the report said.

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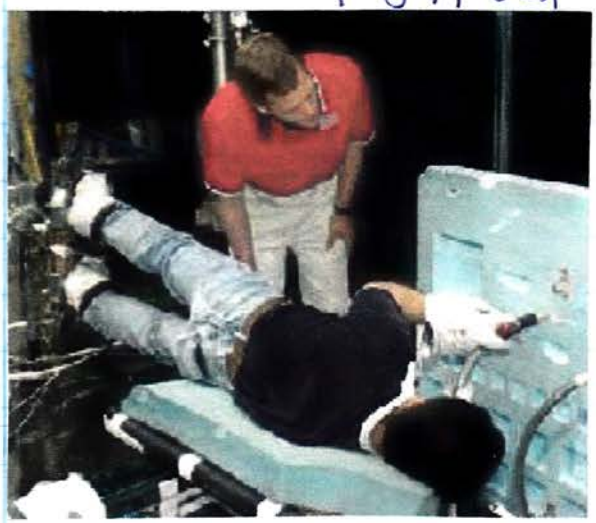

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HOUSTON CHRONICLE : 10 SEPTEMBER 2003.

INVESTIGATORS TO RE-EXAMINE NASA IN A YEAR.

The chairman of the Columbia Accident Investigation Board agreed today to reconvene his panel in a year to analyze NASA's efforts to increase the safety of the space shuttle. Ret. Navy Adm. Harold Gehman Jr., the chairman, was asked in a congressional hearing if he and the board members could report in a year on how vigorously the space agency is following the board's recommendations. "If asked, we will serve," Gehman said. "We know exactly where to go and where to look." He said it would not take long for the 13-member panel to determine if NASA is fulfilling its promise to follow the long list of recommendations included in the board's accident investigation report. House Science Committee Chairman Rep. Sherwood Boehlert, R-N.Y., made the request during hearings on NASA's preliminary plan to follow the recommendations. NASA released its plan Monday. Asked by Boehlert if he would approve the reconvening of the board, NASA leader Sean O'Keefe replied: "By all means. We are always anxious for the input." Gehman said he had talked to the members of the panel about a follow-up study and that the group had agreed. O'Keefe quickly responded, "So ordered." The House Science Committee session was NASA's third before a legislative oversight committee since the Columbia Accident Investigation Board issued its Aug. 26 findings on the causes of the shuttle's fatal breakup. Boelhert, the committee's chairman, urged the agency to slow plans to resume missions as early as March and challenged the wisdom of laying out an ambitious schedule of assembly missions to the U. S.-led internaitonal space station. Though NASA administrator Sean O'Keefe assured the chairman his agency intends to adjust the scheduling of missions in response to the pace of shuttle safety upgrades recommended by investigators, congressional concerns and White House directives, Boehlert was unsatisfied. "I'm concerned the target is exceedingly ambitious and could skew NASA's efforts to return to flight," he said. The committee was especially concerned with the agency's still unspecified plans to address one of the board's requirements, the creation of a new technical engineering authority that would independently establish safety requirements and allow waivers to them. Gehman's investigators discovered that even before the Columbia accident, shuttle program managers were flying with 3,233 waivers to equipment whose failure could result in the loss of the spacecraft or crew. The space agency has been given the job of undertaking a review of the waivers but has not specified whether the task will be undertaken by the new safety center, the shuttle program or the still-to-be created technical engineering authority. Gehman told lawmakers NASA's proposal to establish a new safety and engineering center at the agency's Langley Research Center in Hampton, Va., does not appear to fulfill that requirement. "It's a first step," said Gehman. In their findings, the 13-member panel chaired by Gehman blamed the Feb. 1 shuttle breakup on a collision between a breakaway chunk of shuttle fuel tank foam insulation and Columbia's left wing. However, investigators believe deep-seated management and safety lapses lulled shuttle program officials into believing a long history of foam losses was not a safety threat. Board members specified sweeping organizational reforms so that other potential shuttle hazards could be addressed to prevent another tragedy. Investigators said part of that prescription included removing the perception among lower level engineers and technicians that they were under management pressure to meet flight schedules. Boelhert and others asked how O'Keefe can hope to tackle the reforms, make the safety upgrades and attempt to launch four space station assembly missions in 2004. "If we have to make adjustments to that schedule, so be it," said O'Keefe. "It might be more realistic to make any adjustments sooner than later." said Boehlert. Other committee members raised the prospect of lowering the shuttle flight requirement by turning to either the U. S. aerospace industry or NASA's foreign space station partners. They could furnish unmanned rockets to fly supplies to the station, they said. U. S. Rep. Nick Lampson, D-Beaumont, also urged O'Keefe to speed up the White House process of re-assessing the nation's future human space flight goals, a step in the process of helping lawmakers decide when the shuttle should be replaced with a successor. O'Keefe said the Bush administration is involved in a fact-finding exercise to present the president with a range of options. However, the administrator could not tell the committee when Bush would be ready to propose revisions in the nation's space policy.

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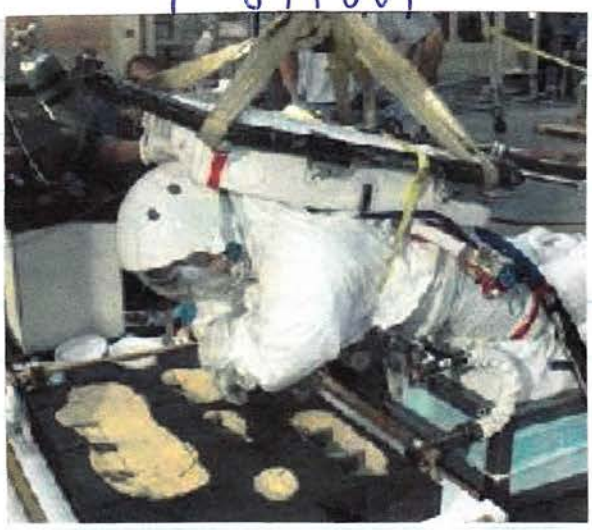

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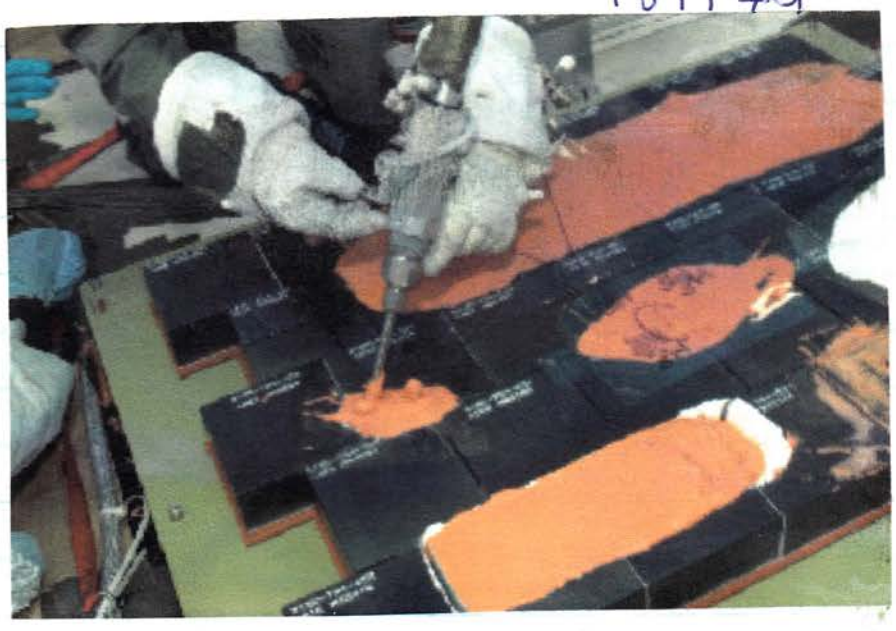

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HOUSTON CHRONICLE : 10 SEPTEMBER 2003.

SHUTTLE DEBRIS PACKED UP FOR RESEARCHERS, MUSEUM.

CAPE CANAVERAL - Workers at Kennedy Space Center are packing up the 84,000 pieces of the space shuttle Columbia for storage. But unlike debris from the Challenger, some remnants will be available to researchers and perhaps someday put on display in a museum. "The overall goal ... was to make Columbia available to do further science and research, not only by the shuttle community but other contractors, universities and scientists," said Scott Thurston, who was the vehicle manager for Columbia. NASA hasn't decided whether any pieces of the shuttle will ultimately be given to the Smithsonian National Air and Space Museum in Washington, but that institution has the right of first refusal for all excess NASA property. "They know our interest and they're considering a variety of options," said museum space history curator Valerie Neal, who has toured the debris spread out in a space center hangar. The debris from Challenger was put into two abandoned missile silos at Cape Canaveral Air Force Station after the 1986 disaster. NASA chief Sean O'Keefe has vowed that will not happen with Columbia. Next week, boxes of the collected parts, representing 39 percent of the shuttle, will be trucked 1 1/2 miles away to the 16th floor of the Vehicle Assembly Building. That is the building where the shuttle orbiter is attached to the external fuel tank and solid rocket boosters before launches. It is a time fraught with mixed emotions tinged with relief for the workers who combed the woods of east Texas for debris in the weeks after the Feb. 1 disaster and those who spent months assembling the pieces in the 50,000-square-foot hangar in an effort to identify parts for investigators. Officials hope to have the hangar cleared by Oct. 1. "This is rough for me," said Carl Vita, a technician with NASA's contractor, United Space Alliance, as he viewed pieces of the fuselage he used to work on. A parade of NASA contractors, aeronautical designers and crew members, such as astronaut Kevin Kregel who flew on Columbia in 1996 and 1997, have been getting last-minute tours of the debris this week, trying to glean any lessons about the breakup of hypersonic aircraft before the debris is stored away. Kregel examined the debris for work he is doing on the next generation of space transportation, the orbital space plane. "You see some of the debris and you see why some pieces survived and others didn't," Kregel said. "You have all this evidence here that can help." Besides the Smithsonian, other museums and historical societies also have made requests for debris as have several towns that want to create their own memorials to Columbia. NASA has made no decision on those requests either. "It's too early, out of respect for the families of the deceased," said Jim Hull, manager for exhibits and artifacts at NASA headquarters in Washington. Seven astronauts were killed aboard Columbia. Some of Columbia's largest pieces include the landing gear and the window frame. Pieces most likely to interest researchers include thermal protection tiles and parts of the reassembled left wing where a huge gash let in hot atmospheric gases that brought down the shuttle. The hole was caused by a chunk of foam insulation that broke off the fuel tank at launch. About 40,000 shuttle pieces were never identified. More debris likely will be added over time. Every week, Kennedy Space Center workers receive packages containing more debris found in Texas. "Deer season will be an interesting time." Vita said. "That's when we think we'll get a lot back."

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HOUSTON CHRONICLE : 12 SEPTEMBER 2003.

SHUTTLE PIECES HEAD HOME.

CAPE CANAVERAL - NASA officials said Thursday that the wreckage of the space shuttle Columbia would be moved starting next week to its final resting place: an unused room on the 16th floor of the same building where it was prepared for its last mission. The remains -- 85,000 pounds of debris, or 39 percent of the shuttle's weight -- were painstakingly gathered by workers and volunteers in Texas and Louisiana in the weeks after it broke up while re-entering the atmosphere on Feb. 1. They were trucked to a 50,000-square-foot hangar at the Kennedy Space Center here for sorting and analysis. Smaller pieces are in bags and gray plastic boxes. Bigger pieces -- fuel valves, turbopumps and oxygen tanks -- rest on wooden crates. Some of the wreckage is twisted and blackened beyond recognition; some of it is eerily intact. Pieces of the leading edge of the Columbia's left wing, the part that was later determined to have been fatally damaged by foam that struck it on liftoff, have been reassembled inside a plexiglass mold. On Thursday NASA officials took reporters on a final tour of the hangar. "It's still very surreal," said Scott Thurston, vehicle manager for Columbia. But he added, "It's a good feeling to know we're going to try to keep the legacy of research that Columbia stood for, versus sealing her up under concrete." Officials have repeatedly said Columbia's debris would remain available for researchers to study materials and structures that sustained the hellish heat and destructive forces of an uncontrolled re-entry from orbit. The decision is remarkably different from the one made in 1986 after the Challenger disaster. Eight months after the presidential commission on the accident presented its findings, NASA buried all the wreckage in two decommissioned Minuteman missile silos at Cape Canaveral Air Force Station.

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FLORIDA TODAY : 16 SEPTEMBER 2003.

NASA MAY PUSH RETURN TO FLIGHT TO MAY-AUGUST 2004. NEXT 2 MISSIONS LIKELY TO FOCUS ON REPAIR TECHNIQUES.

HOUSTON - NASA's first post-Columbia shuttle flight might not launch until mid-summer or later to give the agency time to make changes recommended by an accident board and ensure Atlantis is safe to fly, officials said Tuesday. Moreover, the next two shuttle flights likely will be dedicated primarily to testing new orbital inspection and repair techniques rather than ferrying fresh crews to, or resuming construction of, the International Space Station, officials said. "We've got to take this slow and easy. We need to understand what we're doing and how we're doing it before we go into some of these more complex station missions," NASA shuttle program manager William Parsons said during a series of briefings at Johnson Space Center in Houston. NASA last week said the next shuttle flight largely would be a developmental test run. Parsons now says NASA probably will stage two such missions. The idea, he added, is to make certain the agency is comfortable with new shuttle inspection and repair techniques before taking on seven daunting construction missions still required to complete the unfinished station. Now four months into his new job, Parsons said NASA no longer considers plans to return the shuttle to flight next March as viable. "We may move this launch date out some months with what we know today," Parsons said. "We will learn more things as we go along over the next few months . . . and we'll have to see where that goes." Shuttle program managers will meet in early October to establish a new target date for the flight, Parsons said. Among the options: Launching the next shuttle flight some time between May 19 and June 28 or the period that stretches from July 18 to Aug. 26. Either time frame would enable NASA to launch the shuttle in daylight and make certain its 15-story external tank is on the lighted side of Earth when it is jettisoned. Those caveats are meant to ensure the agency can capture sharp pictures of the shuttle's tank in flight. Doing so will enable NASA to photographically document any debris that might break free from the 15-story fuel reservoir. The Columbia Accident Investigation Board blamed the Feb. 1 disaster on a piece of foam insulation that fell off the shuttle's external tank 81 seconds after its Jan. 16 launch. The 1.7-pound foam chunk struck the shuttle's left wing, opening up a fatal breach that led to its disintegration in the skies over East Texas. The agency tentatively had planned to launch Atlantis between March 11 and April 6. NASA flight director Paul Hill said that the agency is making progress in developing a means to repair damage to any of the 25,000 thermal tiles. But the agency has had less success in figuring out how to patch composite carbon panels that serve as thermal armor for the shuttle's wings, Hill said. The delay in returning NASA's three remaining shuttles to service is creating some uncertainty for the near-term future of the space station, a $100 billion outpost being built by the U.S., Russia, Europe, Canada, Japan and Brazil. The majority of the parts needed to complete the U.S. core of the station -- or some 106,000 pounds -- are now in launch-ready condition at Kennedy Space Center. A Japanese science laboratory also has been delivered to KSC. "We're be ready when the shuttle is ready," said William Gerstenmaier, manager of NASA's space station projects office.

COLUMBIA INVESTIGATION

Columbia report delayed as previous orbiter breached revealed

The Columbia Accident Investigation Board (CAIB) has delayed publication of its 400-page report into the STS-107 accident from late July to about late August. Half of the report is expected to focus on NASA management systems.

Meanwhile, it has been revealed that the leading edge of a wing of the Space Shuttle Atlantis was breached during re-entry in 2000.

The CAIB released a preliminary report on 11 July detailing the damage caused to part of the left wing leading edge of Columbia during the launch of STS-107 that led to its destruction and the death of its seven-person crew during re-entry.

It is estimated that a breach of between 6 in to 10 in was caused to the reinforced carbon-carbon panel No 8 by a chunk of insulation shed from the bi-pod region of the external tank.

The impact also caused surrounding cracks and broke a lug fitting which caused a T-seal between panel 8 and 9 to open and close during entry, resulting in the intermittent heating observed in telemetry readings.

One of possibly two fragments blown into the panel No 8 breach by the impact was probably the object seen floating away from the orbiter in exterior images transmitted during the mission.

CAIB chairman Harold Gehman says that half of the report will detail contributory factors of NASA 'management shortcomings'. These include the cursory rejection by mission controllers that the foam impact had caused any fatal damage to the orbiter's left wing.

The report will also state 'that no Shuttle is going to fly with a bi-pod ramp again', said Gehman. It is also expected the the CAIB will recommend that despite having flown over 100 missions, the Space Shuttle should be still regarded as an experimental or developmental vehicle.

It has been revealed that the Space Shuttle orbiter Atlantis suffered a small breach on a wing leading edge butterfly gap filler between two heatshield panels during re-entry at the end of the STS-101 mission to the International Space Station in May 2000.

There was no 'irreparable damage' and the orbiter flew again on STS-106 in September 2000.

The breach was caused by an improperly installed seal during an overhaul at Boeing in 1997, which became dislodged, creating a 1/4 inch gap between insulation materials.

Some parts behind wing panels were covered with a glassy material, and titatium and Iconel components were charred and scorched. An order was made to improve the installation of sealant materials.

STS-101 commander James Halsell and two other crew members, Susan Helms and Mary Ellen Webber, do not recall being told of the breach by NASA.

'Usually the crew will receive a rundown of all anomalies generated during the Shuttle flight and should have heard about this,' Helms said.

NASA warned of potential bolt problem

NASA and the US Congress was warned in January 2002 that the bolts that connect the solid rockets boosters to the external tank of the Space Shuttle and which are sheared at booster separation, plus the 'boltcatcher' system, had the potential of causing a 'Challenger-type' accident.

A new company - as yet unidentified - had been contracted to manufacture the bolt systems in 2000 after the existing contractor, Hi-Shear, lost the contract.

Hi-Shear was so concerned about the quality of the the new company's work that it notified NASA and Congress that the systems were 'potentially faulty and guaranteed to cause disaster'.

The CAIB said on 12 June that the boltcatcher systems did not appear to have been properly tested and did not have adequate safety margins.

During the launch of the STS-107 Columbia mission - when ET foam was seen to hit the orbiter's wing, probably causing the damage that resulted in the craft's destruction - a piece of debris was also seen on radar in the vicinity of the orbiter at SRB separation. This is thought to have possibly been part of the bolt system that had not been 'caught' in the boltcatcher.

This is not thought to have had any bearing on the Columbia accident, however. It is almost certain the the CAIB will recommend that the bolt system be throroughly tested before the Space Shuttle returns to flight, together with other improvements related to the actual cause of the accident.

NASA's director of the Kennedy Space Centre, the former Shuttle pilot, US Air Force General Roy Bridges, appears to be the third high ranking casualty of the Columbia STS-107 accident, following Shuttle director Ron Dittemore and Marshall Space Flight Centre director, Art Stephenson.

Bridges has been moved to lead the NASA Langley Research Centre and will be replaced by deputy director James Kennedy until a new leader is appointed.

Sean O'Keefe, the NASA administrator, says that it is possible that the Space Shuttle will fly again in April 2004, adding that NASA will exceed safety recommendations made by the CAIB. NASA has to 'correct everything we think might stand in the way of flying as safely as humanly possible', he said. NASA's analysis of the dynamic flow around the Shuttle during launch had indicated that there was no chance the foam from the external tank could hit the orbiter. 'We were wrong,' said Bill Readdy, the former Shuttle commander and now NASA's associate administrator for space flight.

The next Shuttle will be launched in daylight, as all future craft will be. 'We want to make sure every square inch on this is photographed,' said O'Keefe. Readdy confirmed that it was almost certain that insulation will be removed from the bi-pod region of the external tank and will be replaced by heaters, to reduce ice build-up.

NASA faces painful and radical reorganisation

A radical reorganisation of NASA will be among the three major recommendations to be made by the the CAIB as part of its report into the STS-107 Columbia accident in which seven crew were killed during re-entry on 1 February.

The reorganisation of NASA will be 'painful', said Sean O-Keefe, the agency's administrator. Harold Gehman, the CAIB director, said that he will not tell NASA how to organise 'but will tell them what needs to be done'. He added, 'it is not just the foam that NASA has to do something about'. The CAIB has previously criticised NASA for 'missed signals' and 'bureaucratic bumbling'.

O'Keefe warned that when the report is issued 'it's going to be ugly...this is not going to be anything that anybody's going to be particularly happy with'.

One recommendation will be to ensure that crews are trained and equipped to conduct in-orbit repairs to the orbiter - including the heatshield components - during EVAs.

This will include the transporation of the remote manipulator system (RMS) and EVA suits equipped with small manned manoeuvring units, called Safer on all flights.

Ronald D. Dittermore, a 26-year NASA veteran who stepped aside as the Space Shuttle Program Manager at the Johnson Space Center in Houston after the Columbia accident. NASA

It has been revealed that as a warning to the STS-107 flight crew about a possible question during an in-flight press conference about the impact of insulation from the external tank on the left wing of the orbiter during launch, a flight director e-mailed commander Rick Husband telling him that there was no cause for worry. 'We have seen this phenomenon on several other flights and there is absolutely no concern for re-entry,' Steve Stich told the crew.

The CAIB is expected to recommend that NASA regards the Space Shuttle as an experimental vehicle, rather than an operational spacecraft, and therefore subject to additional testing and study. NASA unofficially declared the Shuttle operational on its 100th mission, although in the early days of the programme, when it was envisaged that the spacecraft would fly 50 times a year, it was declared operational by President Reagan after four flights in 1982.

The CAIB will also call for much better photographic coverage of Shuttle launches, using not just ground cameras but those on ships and planes. Two sets of long-range ground cameras provided coverage of the STS-107 launch but a third camera failed. The images from these also lack resolution and are often out of focus. 'This is simply unacceptable from an engineering perspective,' said a CAIB member. An improved web-cam of the type that was fixed to the top of

Space Shuttle bi-pod redesign likely

Five potential redesigns of the bi-pod area of the Space Shuttle external tank where struts fixed on a slightly elevated platform on the ET are attached to the nose of the orbiter have been identified.

The most likely fix will be to eliminate the foam on the bi-pod region and install heaters to prevent ice build-up.

The CAIB is expected to demand a redesign of this area before a return-to-flight of the Shuttle. NASA still hopes to start flying again in the first quarter of 2004.

It is thought that foam insulation shed from the bi-pod area at T+81s into the launch of STS-107 Columbia on 16 January caused the damage to the orbiter's left wing which started the chain of events that led to the craft's distintegration during re-entry on 1 February, resulting in the loss of the seven crew.

The CAIB is expected to cite 'excessive waivers' among factors that contributed to the loss of Columbia and its crew on 1 February.

However, to put the situation into a perspective, 'in virtually every situation a waiver is a carefully thought out process by which you decide that something is an acceptable risk,' said Richard Bloomberg, former chairman of NASA's Aerospace Advisory Panel.

At least 5800 waivers were recorded when Columbia was launched on 16 January, including 1672 potential problems that could have destroyed the orbiter.

If every aerospace waiver was refused then nothing would fly but when a high number of waivers are accepted, their importance becomes institutionally diluted and routine. It is a delicate balancing act.

CAIB chairman Harold Gehman says that the Space Shuttle may return to flight within six to nine months and that the 'next couple dozen missions will be the safest in years'. However, he adds that 'to fly the Shuttle long term for 20 years more, there needs to be work on basic management changes'.

NASA has been guilty of 'bureaucratic fumbling and administrative missed signals'. NASA's HQ safety office staff was cut from 86 to 47 in 11 years, it has also been revealed. There should be 'a sense of urgency' about NASA developing a new generation spacecraft to replace the Shuttle. It is expected the CAIB will conclude that the loss of the Columbia orbiter and its crew was the result of damage to the reinforced carbon-carbon heatshield panel No 8 on the left wing, which allowed hot gases to invade the internal structure of the wing leading to its eventual destruction and separation from the orbiter.

It is possible that Columbia glided many miles above Texas with the half of the left wing missing before the final disintegration of the vehicle. The CAIB is expected to report that the most probable but not 100 percent certain cause of the damage was impact of a piece of insulation foam from the external tank (ET) at T+18s after launch, says board member Roger Tetrault.

The CAIB will conclude that although NASA cannot eliminate insulation shedding totally, NASA must find ways of eliminating the loss of large chunks and is expected to recommend improvements to the bi-pod region of the ET. The orbiters wings must also be strengthened and crews trained and equipped as a matter of routine, to perform emergency repairs to the heatshield in orbit. NASA has also released 92 recovered images taken by the lost STS-107 crew in orbit, including the traditional crew portrait, and 10 hours of video.

the external tank which featured spectacular coverage the launch of the Shuttle Atlantis in October 2002 may become a permanent fixture, but ways to protect it from debris created by solid rocket booster separation will have to be provided.

'We've got an awful lot more to understand about this vehicle,' said Bill Readdy, of the Space Shuttle. Readdy, NASA associate administrator for spaceflight, says that NASA did not understand the aerodynamics that caused the loss of foam from the external tank during several launches. A piece of foam - the largest ever - hit the leading edge of the wing of the Space Shuttle orbiter Columbia causing the damage which resulted in the loss of seven lives on 1 February. NASA administrator Sean O'Keefe says that 'we've got to look at trend analysis' - and things NASA was taking for granted.

O'Keefe plans to establish a new safety and engineering organisation.

Ralph Rose, the Space Shuttle's engineering chief at the Johnson Space Centre, Houston, is the latest casualty of the Columbia accident. He is being reassigned as special assistant to the director of the NASA's Langley Research Centre. The director is Roy Bridges, who had earlier been reassigned from leading the Kennedy Space Centre. Shuttle programme manager Ron Dittemore was the first to depart after the STS-107 accident. It has been reported that Linda Ham, the STS-107 mission manager team leader will also be reassigned.

The CAIB says it has almost certainly made the connection between the impact of foam from the external tank during the launch of STS-107 on 16 January to the loss of the Columbia orbiter and its seven crew during re-entry on 1 February. The seventh and final pressurised nitrogen gas gun impact test at the Southwest Research Institute in which a 0.75 kg piece of foam was fired at a carbon-carbon reinforced panel removed from the leading edge of the orbiter Atlantis, resulted in the entire width of the 30 cm foam hitting the wing, creating a hole with a diameter of 40 cm and even damaged some measuirng equipment. "I think foam hitting the wing leading edge of the orbiter at 800 kph is the direct cause' of the accident," said CAIB member Scott Hubbard.

"The force of the one ton, 530 mph impact surprised observers and there was additional 'collateral damage'," said Hubbard. High-speed video showed an initial rip that "tears all the way across the panel and produces the hole. The hole is very ragged, about 16 inches by 16 inches, or about 256 square inches. There are a number of pieces that are inside the wing leading edge as well as pieces that fell outside."

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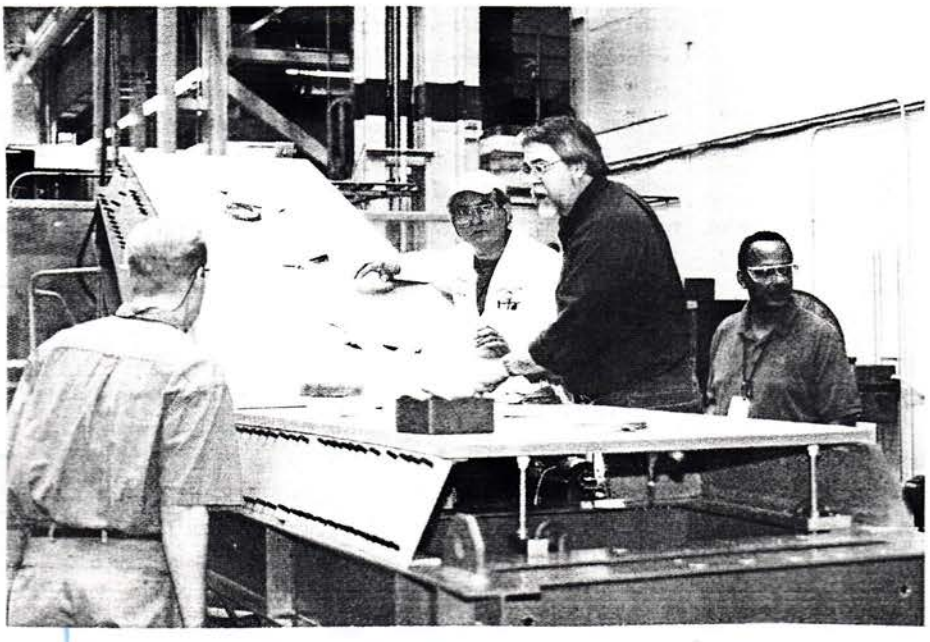
Technicians at the Johnson Space Center team up to assemble a test article to simulate the inboard leading edge of a Space Shuttle wing as a part of the Columbia Accident Investigation Board's testing. NASA



Rush to Return

Congress worried about haste, lack of vision as NASA prepares its return-to-flight plans

FRANK MORRING, JR./WASHINGTON

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NASA has already drawn a go-slow warning from key members of Congress as it prepares its plans to get the three surviving space shuttles flying again, reflecting both safety concerns and fears the U.S. space agency doesn't have a clear vision of what it wants to do in space over the long haul.

Reacting to the first public version of NASA's return-to-flight plan, lawmakers on the House Science Committee worried that there is too much unfinished work in the plan to complete by Mar. 11, 2004, which NASA is holding as the first possible date for the next shuttle mission. But beyond that, panel members complained the White House is holding its long-term space policy planning too close to the vest for meaningful participation by Congress, much less by the public.

Both worries draw on the Columbia Accident Investigation Board (CAIB) report, which cited perceived pressure by mission managers to keep International Space Station assembly on an impossibly tight schedule as a factor in the Feb. 1 shuttle accident. The board also called for "a full national debate" on how to improve human access to space, regardless of the ultimate goals of human space exploration.

"I'M STILL CONCERNED that the target is exceedingly ambitious and could skew NASA's efforts to return to flight," said Rep. Sherwood Boehlert (R-N.Y.), chairman of the House science panel that is the principal NASA oversight body on Capitol Hill.

Both Administrator Sean O'Keefe and William F. Readdy, associate administrator for spaceflight, have stressed that Mar. 11 is a "no earlier than" target designed to propel the return-to-flight effort, rather than a hard deadline. In releasing the return-to-flight plan, Readdy noted that other launch windows would be available May 19-June 28, 2004, July 18-Aug. 26, 2004, and beyond.

"[With] any kind of complex system, you need to be able to drive out what the issues are that may be just a little bit below the surface—technical issues, some of them may be programmatic issues, some of them may be operational issues," Readdy said Sept. 8. "The only way to be able to tease those out, to drive those out, is to set some kind of planning date."

O'Keefe told the House panel that top NASA management "failed to make sure that message was clearly understood" before the accident, when the shuttle program was struggling to launch the Italian-built Node 2 to the space station by Feb. 19, 2004.

The return-to-flight plan Readdy released was a "living document" describing the status of NASA's response to the 15 recommendations the accident panel said should be met before the next shuttle launch, based on its finding that Colum-

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bia was destroyed on reentry because a piece of insulating foam fractured the thermal protection system on its left wing leading edge. Basically, the recommendations involve preventing debris during launch, hardening the shuttle to withstand debris strikes, and improving the ability to spot and repair damage after launch (*AW&ST* Sept. 1, p. 22).

Longer term, the plan calls for the service life extension program that was already underway when Columbia was lost to study how its plan for a "midlife recertification" meshes with the accident panel's call for recertification if the shuttle continues to fly after 2010. It sets a December deadline for completion.

One of the topics under study is rigging the three remaining shuttles to fly without a crew on board. The accident board called for NASA to replace the shuttle as soon as possible, and to separate the crew from the cargo once it does. NASA is trying to accelerate the proposed Orbital Space Plane—a crew-only vehicle that would initially be launched on a Delta IV or Atlas V—for a first flight in 2008, something O'Keefe said would be expensive. But the shuttle still would be needed for the outsize cargo loads that must go to the ISS.

Like the plans to return to flight next March, O'Keefe termed plans to fly four shuttle missions to the ISS in 2004 "notional" and dependent on meeting the "milestones" set by the accident panel. But he also stressed the need to proceed with station assembly as soon as safely possible. To that end, he decried a decision by the Senate Appropriations Committee to cut $200 million from the administration's Fiscal 2004 request for ISS, on the theory that the money won't be needed because operations have slowed.

"It will be more difficult if we're starting in a hole," O'Keefe said.

At the same time, he was unable to tell the House panel how the administration will handle its funding requirements for the return-to-flight effort. The agency changed its operating plan to shift $40.2 million in the current fiscal year from science, aeronautics and technology accounts to the human spaceflight account to cover support to the accident investigation and early return-to-flight efforts. But beyond that, O'Keefe said, the budget implications of the Columbia accident must await the outcome of internal administration deliberations on the nation's long-term space exploration plan.

"The target is **exceedingly ambitious**"

Under questioning about the shape of those deliberations, O'Keefe described them as a "normal" interagency review to prepare policy options for President Bush's decision. Vice President Dick Cheney has also been involved, he said, as well as representatives of the Defense and Commerce Depts. and other agencies with a stake in space activities.

As in past appearances, O'Keefe was unable to say when Bush would announce a new space exploration policy. Democrats on the House panel questioned how Congress and the public would be involved, while some panel Republicans joined in the call for a clear "vision" for U.S. space activities.

"It seems to me that there needs to be a mission statement by the President of the United States," said Rep. Dana Rohrabacher (R-Calif.), who chairs the House Science subcommittee that oversees NASA. He suggested ceremonies in Kitty Hawk, N.C., marking the centennial of human flight on Dec. 17 as an appropriate venue for a presidential announcement.

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AVIATION WEEK & SPACE TECHNOLOGY SEPTEMBER 15, 2003

SPACEFLIGHT NOW : 16 SEPTEMBER 2003.

NASA MANAGERS RE-THINK NEXT SHUTTLE LAUNCH DATE.

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HOUSTON - In the coming weeks, NASA managers hope to establish a new target launch date for the resumption of space shuttle missions after they acknowledged Tuesday that a mid-March liftoff wasn't plausible. While recently laying out its return-to-flight game plan, NASA said shuttle Atlantis could be launched as soon as March 11, 2004. But the space agency came under fire from lawmakers in Washington for a perceived belief -- correctly or not -- that shuttles were being rushed back into action. Shuttle program manager Bill Parsons told reporters here Tuesday that the winged spaceplanes wouldn't fly in March or April, and said NASA leaders will meet early next month to select the new target. "Over the next couple of weeks we will be putting together all the rationale of when a good launch date might be appropriate. Right now, we are looking at all the different pieces of hardware that has to be developed, the different things we have to do," Parsons said. The next available launch opportunity extends from approximately May 19 to June 28. By launching during that period, Atlantis will make its ascent and separate from the external fuel tank in daylight. As part of the return-to-flight philosophy, engineers want the best possible photographic coverage of the shuttle and jettisoned tank to look for any debris shed from the tank during the climb to orbit. Another daylight launch period extends from approximately July 18 to August 26. Atlantis' mission -- STS-114 -- was originally envisioned to launch about one month after Columbia's landing to ferry a new resident crew to the International Space Station. Columbia's tragic disintegration in the skies over Texas on February 1 changed all of that. Officials said Tuesday that Atlantis' mission was being revamped to only deliver critical supplies to the station, allow the astronauts to test shuttle inspection techniques and practice repairing thermal protection tiles during a spacewalk in the orbiter's payload bay. Atlantis' four-person crew -- commander Eileen Collins, pilot Jim Kelly and mission specialists Stephen Robinson and Soichi Noguchi -- likely will receive two or three new crew mates to help with the flight's busy workload. "The crew size and make up is being discussed," said Parsons. "We know there won't be a crew rotation on the next mission. So that is out. We also know it takes at least six crew members to do all things that we need to do safely." With shuttles grounded, the station's Expedition crews were slimmed from three to two people due to limited supplies aboard the station. But one astronaut launched on Atlantis could remain on the station to restore the outpost's full-time three-person staff. NASA is also considering adding another shuttle test flight that would be inserted into the schedule following STS-114 and before station construction activities resume on STS-115 with the delivery of a massive, 35,000-pound solar array truss structure. The extra flight, while conducting more shuttle test objectives, also would complete station tasks deferred from STS-114 and accomplish some "get-ahead" work slated for the logistics and crew rotation flight of STS-116, officials said. "We've got to take this slow and easy. We need to understand what we're doing and how we're doing it before we go into some of these more complex station missions," said Parsons. Station program manager Bill Gerstenmaier indicated that both STS-114 and the potential new flight -- pending final approval -- will carry Italian-built cargo modules. The so-called Multipurpose Logistics Modules are launched in the shuttles' payload bays and then mounted to the station to deliver supplies, hardware and experiments to the outpost. The reusable modules are brought back to Earth by the shuttle. Starting with the solar array mission of STS-115, a half-dozen shuttle flights are planned to significantly grow the station and finish the U.S. core of the complex. Building the station in space had progressed remarkably well over the past couple of years without any major hiccups. Prior to the Columbia accident, that "U.S. core complete" status was expected in February 2004 with the launch of the Node 2 module. Gerstenmaier said the final push to finish the station was ready to begin once Columbia returned home from its 16-day science mission -- a rare non-station mission by the shuttle. "As a program manager, I likened it to an athlete that was trained for a marathon. We were as poised at the beginning 2003 as we could ever be for this period of assembly. We had the right consumables on orbit, we had the ground teams trained, we had the hardware ready to go fly. We were ready, really ready. We were at our peak performance. "Now, we are not executing and in this hold mode. So how do you keep that same level of preparedness during this expended period of time? What we have doing now is just backed off a little bit. We will pick the right point, once we are ready to get back into the assembly sequence, and we will start that building up again and honing to get ready to execute. "That is why I think it is very helpful to get these two shuttle test flights that are more geared to shuttle than station. That gives us a chance to get back in the groove, get back into the assembly sequence. My challenge is how do we get ready to get back into assembly again when we don't know when that will be."

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FLORIDA TODAY : 17 SEPTEMBER 2003.

RULES PUSH LAUNCH BACK.

HOUSTON - NASA will have to fly its first post-Columbia shuttle mission by mid-October 2004 or face a potential delay of 4½ months because of new rules on acceptable lighting conditions during launch, officials said Wednesday. The new rules effectively will prohibit NASA from launching shuttle missions during about six months of every year, a fact that will limit the agency's ability to complete construction of the International Space Station. Senior shuttle managers, however, insist that the restrictions will not create the type of schedule pressure that contributed to both the Feb. 1 Columbia disaster and the 1986 Challenger explosion. In both cases, investigators found that NASA allowed pressure to maintain ambitious launch schedules override safety concerns that ultimately doomed seven-member astronaut crews. "We have to guard against that, and it's going to be hard," John Shannon, NASA's manager for flight operations and integration, told reporters during a series of briefings at Johnson Space Center. "But that's not the way we're going to operate." Almost all shuttle launches for the foreseeable future will be missions to the international station, including two developmental test runs NASA aims to fly before resuming construction of the unfinished outpost. Launches to the station already were limited to time periods when a shuttle docked to the outpost would not be exposed to sunlight more than 72 percent of each orbit. The concern is that extremely hot temperatures could foul shuttle systems. New post-Columbia rules now dictate that shuttles be launched during daylight so that the agency can photographically document the ship's external tank in flight so any breakaway foam insulation can be detected. For the same reason, launches also must take place during times when the shuttle's external tank is jettisoned on the sunlit side of Earth. The idea is to be able to spot any missing foam insulation as the 15-story fuel reservoir falls away from the shuttle. "We learned a hard lesson (from the Columbia accident) that we don't understand everything that's going on with this vehicle and we've got to put the things in place to broaden our understanding," Shannon said. "And if a piece of that is having lit launches so we can get that data, then that's what it takes." Coupled together, the new restrictions cut in half the number of launch opportunities station-bound shuttles have during any given year, said Greg Oliver, chief of NASA's Ascent/Descent Dynamics Branch at JSC. In 2004, NASA effectively will be limited to launching during four time periods: roughly March 11 to April 6; May 19 to June 28; July 18 to Aug. 26 and about a three-week period between mid-September and mid-October. Two three-day launch opportunities exist in November 2004 and January 2005, respectively. But NASA would be unable to launch in late October and November 2004 as well as much of January, February and March 2005. Senior NASA officials said Tuesday that the launch opportunity between March 11 and April 6 next year no longer is considered a viable option. NASA needs more time to make changes recommended by the Columbia Accident Investigation Board, the official said. The agency expects to set a new target launch date for returning the shuttle fleet to service in early October 2004. Where shuttles will land in the future also is in question. NASA -- for the first time in 22 years of shuttle flights -- is conducting an assessment to determine the risk posed to the general public during atmospheric reentries and landings. The study follows a Florida Today report in May that showed a Columbia break-up about a minute earlier on Feb. 1 would have exposed highly populated suburbs in Dallas-Fort Worth to falling debris. Preliminary results show that the risks to the public are about equal when it comes to landing at Kennedy Space Center, Edwards Air Force Base or White Sands Space Harbor in New Mexico, Oliver said. Further analysis, however, will be needed to determine exactly where NASA will send shuttles for future landings.

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ORLANDO SENTINEL : 18 SEPTEMBER 2003.

WHEN IS THE SHUTTLE READY??

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HOUSTON - If NASA isn't ready to launch a space shuttle by fall 2004, the return to flight may have to wait until March 2005, thanks to new rules that cut the launch opportunities in half. The National Aeronautics and Space Administration has declared that all launches for the foreseeable future will happen in daylight, so that cameras can film the shuttle as it streaks into orbit and record any debris that might damage the orbiter. The agency is adding more cameras and converting others to digital to ensure clear images of the external fuel tank, the source of an estimated 1.67-pound chunk of foam that flew off the shuttle Columbia and smashed into the left wing. Investigators think the foam did enough damage to the wing to allow superhot gases to get in during re-entry, which destroyed the shuttle and killed its crew Feb. 1. The daylight mandate dramatically reduces the number of days NASA can launch, said Greg Oliver, chief of the shuttle program's ascent/descent branch at Johnson Space Center. When combined with other conditions that dictate when a shuttle headed for the international space station can launch, he said, the opportunities are further curtailed.Throughout next spring and summer, there are roughly monthlong blocks in which all of the conditions can be met. But after early October, there are only a handful of days in November and January -- and none in December, February or early March -- when a shuttle could fly. "In the November-to-January time frame, we're talking about maybe three tosix days available to us," Oliver said. Shuttle missions are already famously complicated to schedule and launch, with weather, technical glitches and myriad other factors playing a role. Launching to the space station is even more complex.For starters, because of the orbit of the station and the rotation of the Earth, NASA can carve out only one, five-minute launch window each day to get to the orbiting laboratory from Kennedy Space Center. That's one reason that six of the 16 launches to the space station have occurred at night.In addition, the "beta angle" -- the angle between the sun and the plane of the station's orbit -- must be factored in, to avoid exposing the orbiter to too much sunshine -- and too much heat -- while it is docked at the station. John Shannon, the shuttle program's flight operations and integration manager, said it's uncertain just how the constraints will affect the station, which has relied on the shuttle to both bring new components into space and ferry crews back and forth. He said the restrictions will not translate into the kind of schedule pressure that accident investigators said might have contributed to the Columbia disaster. But NASA managers must be vigilant to make sure that doesn't happen, Shannon said. "We have to guard against that," Shannon said. "Everybody who's worked here for a long time looks at that thing [blackout chart] and says, 'Wow, we need to get something going here and here and here.' And you say, 'No, we are not going to do that. That is not the way we're going to operate.' "Shuttle-program managers still have almost no idea when they will be able to launch. Work is continuing on the recommendations made by the Columbia Accident Investigation Board, including redesigning parts of the external tank and developing a way to repair the shuttle's thermal-protection system. But they do know that the first flight back -- and possibly a second -- will be largely a test flight. Paul Hill, lead flight director for the next mission, said astronauts will try out the method for inspecting the thermal tiles and reinforced carbon-carbon panels that protect the orbiter from the heat of re-entry. An entire spacewalk will also be devoted to testing the proposed method of repairing the tiles in orbit.

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Extra Shuttle Flight

Shuttle productivity will be hampered in post-Columbia environment

MICHAEL A. DORNHEIM/JOHNSON SPACE CENTER

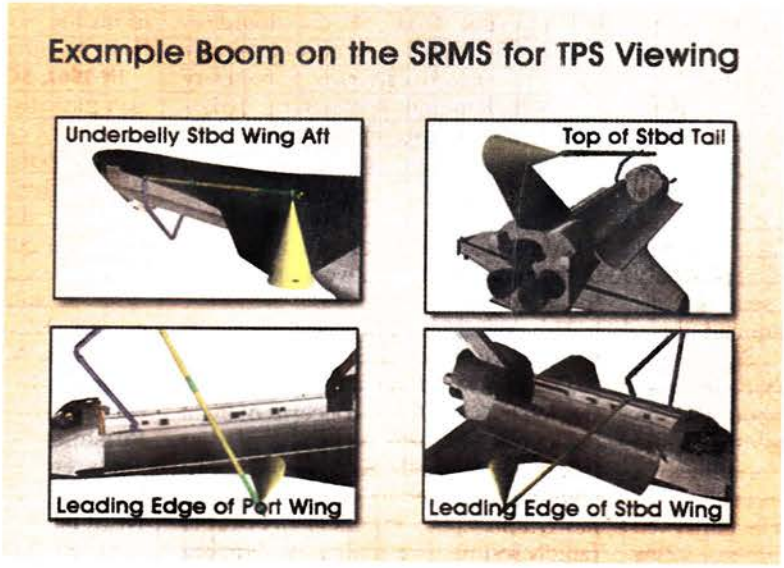
NASA space shuttle officials expect to add a second "return-to-flight" mission before resuming complex operations at the International Space Station, which would push major ISS assembly out a few months, to two missions beyond first flight.

The initial return-to-flight, now already extended to next summer from March 2004 (see p. 25), is Mission STS-114, and officials are talking of a following STS-114.1 to further address return-to-flight issues and ensure the ISS is sufficiently healthy for assembly to continue. Some future ISS work may be moved forward to this new mission.

Overall, shuttle productivity will be hurt by several post-Columbia changes:

- The spacecraft will carry less payload because of the extra weight of adding the normal remote manipulator system (RMS) arm on the left sill of the cargo bay, and a new 50-ft. extension boom stowed on the right sill. Adding the boom to the end of the RMS will make the total length 100 ft., allowing it to access the entire underside of the shuttle for thermal protection system inspection and repair. In the past, to gain extra ISS payload, the normal RMS was not being carried on ISS missions. It weighs about 1,000 lb. The boom is based on RMS structure and may weigh 800-1,000 lb., said Paul Hill, lead flight director for STS-114. There will also be the estimated 350-lb. weight of tile repair equipment. STS-114 is carrying a tile repair experiment that weighs about 500 lb.
- Scanning tiles in orbit will take one full day. If the initial scan shows a problem, about two more days would be needed for further inspection and repair. This would detract from ISS work and require leeway at the end of the mission.
- More conservative operation rules could hurt flexibility and slow decisions, giving a hard-to-quantify hit on productivity.
- Launch windows will be cut in half by the need to photograph each ascent to check for debris. This means the launch must be in daylight, and the external tank must also be in daylight for at least 6 min. after separation over the mid-Atlantic so the crew can photograph it. This particularly reduces launch windows in autumn and winter. Launches to the ISS are not possible in December, February and March, and only a few days are available in November and January, said Greg Oliver, chief of the Ascent/Descent Dynamics Branch here.

New hardware and rules require that some payload be deleted, that there is less ISS rendezvous opportunity, and that more time be reserved at the ISS, Hill said.



Shuttle remote manipulator system (SRMS) can inspect important parts of the thermal protection system (TPS) when a 50-ft. boom is added to make it 100 ft. long.

One step being taken to regain part of the payload is to let the ISS orbit decay from its nominal 205 mi. to 190 mi. at the time of shuttle rendezvous. This would increase shuttle uplift by 1,500 lb., Hill said. Afterward, the ISS could be reboosted to 205 mi. This would come at the cost of extra ISS drag and propellant usage in the lower atmosphere, but officials said the station is not facing a propellant shortage.

NASA morale was boosted by the recent electrical power-up of shuttle Discovery. It was the first shuttle activation since the Feb. 1 Columbia accident.

Agency officials began to detail the new mode of shuttle operations here last week, but stressed that their plans are still in flux. The return-to-flight implementation plan will be revised one or two times per month, and will soon add an appendix to address the Columbia Accident Investigation Board's "observations," contained in Chapter 10 of the CAIB report.

Thermal protection system damage is to be detected by several types of imaging. First, ground cameras will look for debris near the orbiter. Improvements since Columbia include the requirement to launch in good lighting, an increase in the number of cameras to about 23 from 14, better maintenance of the cameras, and possible addition of cameras farther out on a ship or on a pair of NASA WB-57F Canberra jets at 63,000 ft.

Second, the external tank (ET) will be photographed after separation both by cameras in the ET umbilical wells on the shuttle belly and by the astronauts out the windows. Improvements over past practice include the requirement to do this on every flight in good lighting conditions, more digital cameras in the cabin for quick downlink to ground analysts, and a digital camera in the right ET well. Also, cameras on the ET and the solid rocket boosters will be used on each flight and some upgraded to better quality and moved to better positions.

Once in orbit, the RMS, augmented by the 50-ft. boom, will carry a camera around the shuttle to photograph the tiles and reinforced carbon-carbon (RCC) pieces. Difficulties include detecting damage because of low contrast on the white tiles and black RCC, and the need to find small cracks in the

(81190)

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Pink tile repair material is applied by astronaut Carlos Noriega on board the KC-135 zero-g aircraft. Note small void at bottom of simulated tile gouge.

RCC. Hill would like to use a laser radar camera with depth information, but so far the laser radar won't work while the arm is in motion, and it would take too long to constantly stop and start the arm while covering most of the shuttle. This might be fixed with software, but that is far from certain. Using a TV camera with polarizing filters to enhance contrast is the likely near-term technique. The entire process will take at least an entire day. These pictures will be transmitted to analysts on the ground, and they should have a map of any potential trouble spots by the fifth or sixth flight day.

As the shuttle approaches the station on the third flight day, it will stop 600 ft. away and do a pitch pirouette so ISS crewmembers can photograph the surface. The maneuver should take just 20 min., and will complement the pictures taken by the RMS camera. Neither set gives the full resolution desired. The ISS pictures also will be downlinked and analyzed on the ground.

If nothing serious is detected, that is the end of it. But if something is found, areas flagged by the analysts will be given closer inspection by the RMS. This time it might carry the laser radar because there's time to linger at the small number of target sites.

But the prospect of false alarms raises its head. The shuttle has an average of about 30 tile gouges at least 1 in. in size on every flight. Most of these are considered safe after inspection on the ground, but what will the new inflight system conclude?

If this second look indicates an area requires repair, the RMS, and boom if necessary, will place an astronaut at the site. This process will not be available on STS-114; repairs would be made from the ISS arm. The tile repair technique is well along in development, and fills the gouge with MA-25S, a silicone rubber-based ablator material. There's significant concern about making the repair stick to the dusty inside of a gouge. Another problem would be if the boom extension is used—the entire assembly is very limber, moving 16-20 in. with just 5 lb. of force, Hill said. The astronaut should expect a lot of unwanted motion as he presses the repair in place.

Repairs to RCC are not as developed as tile repairs. Four RCC techniques are under consideration, and one might be placed on STS-114 (*AW&ST* Sept. 1, p. 22).

Astronauts will experiment doing tile and possibly RCC repairs in the STS-114 payload bay. They will not be riding the RMS, and will be relatively stable next to the workpiece. Other items on the STS-114 agenda include replacing a ISS control moment gyro, which is required before major assembly continues with the addition of the P3/P4 Integrated Truss Segment with more solar array panel on ISS Flight 12A. This work temporarily creates an asymmetric ISS configuration that produces a large yaw force, and officials want to have at least three control moment gyros (CMGs) working to counter the yaw without having to immediately resort to thrusters. Now only two of the four CMGs are working, and STS-114 is to provide a third working gyro.

The mission carries about 10,000 lb. of cargo to be placed inside the ISS, primarily food and a Safer maneuvering backpack that serves as a safety backup in case an astronaut "falls" out of control during extravehicular activity. There also is an external storage pod to be placed on the outside of the ISS. This activity could be altered if time is needed at the end of the mission for tile inspection and repair.

Safe Haven

Space station's ability to shelter stranded crew, Discovery repairs also drive shuttle flight plan

FRANK MORRING, JR./WASHINGTON

The space shuttle's return to flight has been pushed into next summer by factors beyond improvements to Atlantis, the next orbiter in line to fly, including how long the International Space Station could shelter a stranded shuttle crew, and the availability of another shuttle to go rescue them.

NASA has trimmed 100 days from its first-blush estimate of how long the ISS could support a seven-member shuttle crew, even as it has added at least two months of work to prepare the shuttle Discovery to fly again. So the longer Atlantis stays on the ground, the better prepared NASA would be to shelter and rescue its crew if it suffers the same sort of damage that destroyed Columbia on reentry Feb. 1.

Although not set as a return-to-flight requirement by the Columbia Accident Investigation Board, NASA decided on its own during the probe that it would be "prudent to examine our options for planning an emergency capability to sustain shuttle crews on the ISS should for any reason their orbiter become unfit

for entry." The action was one of several attempts to "raise the bar" on shuttle safety beyond that recommended by the accident board.

Another such action was a decision to pull the actuators on the rudder speed brakes on Discovery after corrosion was found on other actuators on that vehicle during its regular Orbiter Major Modification (OMM) period. As a result, the return-to-flight date for Discovery slipped from no earlier than July 2004 until September 2004.

"The question came up, could there be corrosion on the rudder speed brake actuators?" said Michael C. Kostelnik, deputy associate administrator for ISS and space shuttle. "We typically do not take those off, and have not in a long time, but the engineers for their own reasons thought this was a good idea for the program and decided to do that. That decision is actually what is driving the no-earlier-than flight date on [Discovery]."

ORIGINALLY ISS program managers estimated the station could support six astronauts for 180 days, provided certain conditions were met. Given a seven-person shuttle crew and a two-person ISS expedition, three crewmembers would return to Earth on the station's Soyuz lifeboat. The six left in orbit would use not just the ISS supplies, but those on the stranded shuttle as well—including 1,118 liters of water from the shuttle's fuel cells—while awaiting rescue by a backup shuttle.

Given the September 2004 ready-date for Discovery, 180 days of shelter on ISS would have just about covered the Mar. 11 target flight date. A crew stranded after launching on that date probably could have been rescued by Discovery. But last week ISS Program Manager William H. Gerstenmaier said the 180-day estimate, contained in the first public return-to-flight plan released Sept. 8, had been trimmed to 80 days for a seven-person shuttle crew. At the same time William Parsons, the shuttle program manager, conceded for the first time that the March 2004 target for a return to flight was overly optimistic because of the technical difficulties in meeting the accident board's return-to-flight requirements (see p. 24).

Subsequent ISS launch windows are open May 19-June 28, 2004, and July 18-Aug. 26, 2004. Given the issue of crew rescue from a "save haven" on ISS, the second of those windows probably would be the most likely for a return to flight, provided the technical issues associated with the accident board recommendations can be resolved and approved by the NASA task force established to review the return-to-flight plan.

Early in the accident's aftermath, managers pushed for a prompt return to flight because of the anticipated difficulty of supporting the station using only Russian Progress supply and Soyuz crew transfer vehicles. Kostelnik said that pressure has eased since the ISS crew was cut from three to two to save consumables, and as Russia has demonstrated its ability to provide consistent support. Resupply should become even more robust once Europe's Automated Transfer Vehicle (ATV) becomes available. Tentatively scheduled for a first flight in September 2004, the new cargo carrier could ease logistics pressure on the shuttle program and free Atlantis for more tests of the safety equipment recommended by the accident board (*AW&ST* June 23, p. 17).

Kostelnik said present plans for ISS supply using Russian hardware "takes us clearly through the summer" of 2004, and perhaps beyond that. Russia is scheduled to advance one Progress flight from January 2004 to November of this year, and there should be enough propellant on the station and in the scheduled Progress vehicles to keep the station in its normal orbit for the next year.

A slip beyond the March 2004 launch window will introduce other complications into the equation. Francois Auque, head of Europe's EADS Space Systems Div., whose EADS Space Transportation unit is building the Columbus laboratory module, said last week a slip of more than "a few months" would add cost to the lab that would have to be renegotiated with the European Space Agency.

"Schedule can't be the driver in the shuttle program. . . . **safety must govern."**

But Parsons' announcement that the March date would not be practical drew praise on Capitol Hill, where members of Congress on NASA oversight committees have expressed concern that NASA was pushing too hard to get the shuttle flying again (*AW&ST* Sept. 15, p. 28).

"I was very pleased to learn of Mr. Parsons' statements," said Rep. Sherwood Boehlert (R-N.Y.), chairman of the House Science Committee. "Those statements mean that NASA is beginning to get it. Schedule can't be the driver in the shuttle program. Target dates are fine, but safety must govern. NASA has a lot to do to meet the 15 return-to-flight recommendations of the Columbia Accident Investigation Board and, as I have said repeatedly, the Mar. 11 date struck me as excessively ambitious."

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RETURN TO FLIGHT **Even though they are holding Mar. 11, 2004, as a return-to-flight date for the space shuttle, O'Keefe and other top NASA officials are careful to stress that it is a notional "no-earlier-than" waypoint and not a hard deadline. The Columbia Accident Investigation Board flagged an overambitious deadline for completing the U.S. portion of the International Space Station as contributing to the Feb. 1 disaster, and agency leaders don't want to repeat that mistake. The date is only a management tool, they say, and technical milestones rather than the calendar will drive the actual return. Still, someone has decorated the corridors at NASA with colorful motivational posters that show agency employees hard at work at picturesque space jobs and posing the question "What will I do today to return to flight?"**

22257

Bericht uit de ruimte
Nummer 42 - 26 september 2003

Columbia

De eerste shuttlevlucht na het Columbia ongeluk zal op zijn vroegst op 15 juli 2004 plaatsvinden. De Atlantis zal missie STS-114 uitvoeren, maar de missiedoelstellingen worden danig bijgesteld. Was het originele plan om het ISS te bevoorraden en voor te bereiden op later te lanceren modules, nu zal de bemanning van de Atlantis methodes beproeven om het hitteschild van de shuttle in de ruimte te onderzoeken en eventueel te repareren. Hoewel de shuttle aan het ISS zal koppelen, zal men minder vracht mee kunnen nemen, en is er minder tijd voor werkzaamheden aan het station. Hierom is in september/oktober 2004 een extra vlucht aan het manifest toegevoegd, om alle doelstellingen van de originele STS-114 alsnog te halen. Deze vlucht zal met STS-121 worden aangeduid (de tussenliggende nummers zijn al vergeven). Na STS-121 zal het oorspronkelijke schema weer worden opgepakt, en zal STS-115 een nieuwe set grote zonnepanelen naar het ISS brengen. Het is nog niet duidelijk welke shuttles missies STS-121 en STS-115 zullen gaan uitvoeren.

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FUMBLE The Bush administration's airtight information control system apparently is impervious even to NASA Administrator Sean O'Keefe, an administration insider. O'Keefe was embarrassed last week when House Science Committee Chairman Sherwood Boehlert (R-N.Y.) told him the committee continued to be denied access to internal space shuttle budget information. The Columbia Accident Investigation Board also was denied access to the information, which involves the give and take between NASA and the Office of Management and Budget on shuttle funding. But O'Keefe, a former deputy OMB director, thought he had worked out an arrangement with OMB lawyers that would allow NASA's congressional overseers to look at the relevant documents. "I'll fix that," O'Keefe said after the slipup was brought to his attention in a hearing before Boehlert's panel.

AWST: 15-09-2003.

SPACE.COM : 27 SEPTEMBER 2003.

NASA SEEKS WAYS TO INSPECT SHUTTLE WING PANELS AT KSC

81196

CAPE CANAVERAL - Extensive factory inspections of wing panels between flights could add as much as three months to the time it takes to prepare a space shuttle orbiter for launch, NASA and contractor engineers said Friday. But in response to the Feb. 1 Columbia disaster, the agency is trying to develop techniques that could enable inspections to be performed at Kennedy Space Center. And that capability might negate the need to send panels to their manufacturer in Texas after every flight. "We're in the infancy of that," NASA vehicle manager Scott Thurston said. "Obviously the vendor has got very good, solid techniques they use to do those inspections," he said. "WWill we ever get to the point where we can do it here versus at the vendor? We don't know. We're trying to figure that out." The exact scope of inspections that will be required between missions after NASA returns its shuttle fleet to flight is undecided, Thurston said. Shipping them back to the factory would extend the time it takes to prepare a shuttle for launch from four to seven months, he added. And at least for now, that's the plan. "Right now, on the books, the way we'll do this is pull (wing panels) off every time, between every mission," Thurston said. The Columbia disaster was traced to a wing panel breach that enabled hot gasses to tear the ship apart during an ill-fated atmospheric re-entry. Accident investigators found periodic visual inspections and "touch tests" done at KSC between flights were not adequate to gauge the structural integrity of the shuttle's Reinforced Carbon Carbon panels. Twenty-two of the U-shaped panels form the leading edge of each of the shuttle's wings and protect them from intense heat encountered during atmospheric re-entry. The investigators recommended NASA "develop and implement a comprehensive inspection plan to determine the structural integrity" of the panels, taking advantage of advanced non-destructive inspection technology in doing so. As part of its effort to return the shuttle fleet to flight, NASA plans to send all wing panels from its three remaining orbiters -- Atlantis, Discovery and Endeavour -- back to manufacturer Lockheed Martin in Grand Prairie, Texas. Once there, the panels will be subjected to ultrasound, x-ray and eddy current inspections to detect any defects. The latter technique involves sending an electromagnetic current through panels. An interrupted current serves as an indication of an unseen defect. All 44 of the panels from Atlantis -- which is slated to fly NASA's first post-Columbia mission -- either have been, or are being, inspected in Texas. The 22 panels from the shuttle's left wing were returned to KSC. Four of those were reinstalled on Atlantis. Right wing panels will be shipped back to KSC and put back on the shuttle later this year. Thurston said no significant defects were found in the inspected panels. "We haven't found anything that the vendor or the engineers consider out of character," he said. Shuttle program managers, meanwhile, are evaluating techniques that could enable inspections to be performed without removing panels from the shuttle. The techniques that show the most promise are ultrasound and thermography, the latter of which employs infrared imaging devices to spot hidden flaws. But it remains to be seen whether they will be adequate. Atlantis is in one of KSC's three shuttle processing hangars. The orbiter is expected to be ready for a move to the 52-story Vehicle Assembly Building on Feb. 9. However, the scheduled move is based on a tentatively planned launch March 11, which senior program managers are expected to push back next month. NASA's first post-Columbia flight likely will be rescheduled for launch in July.

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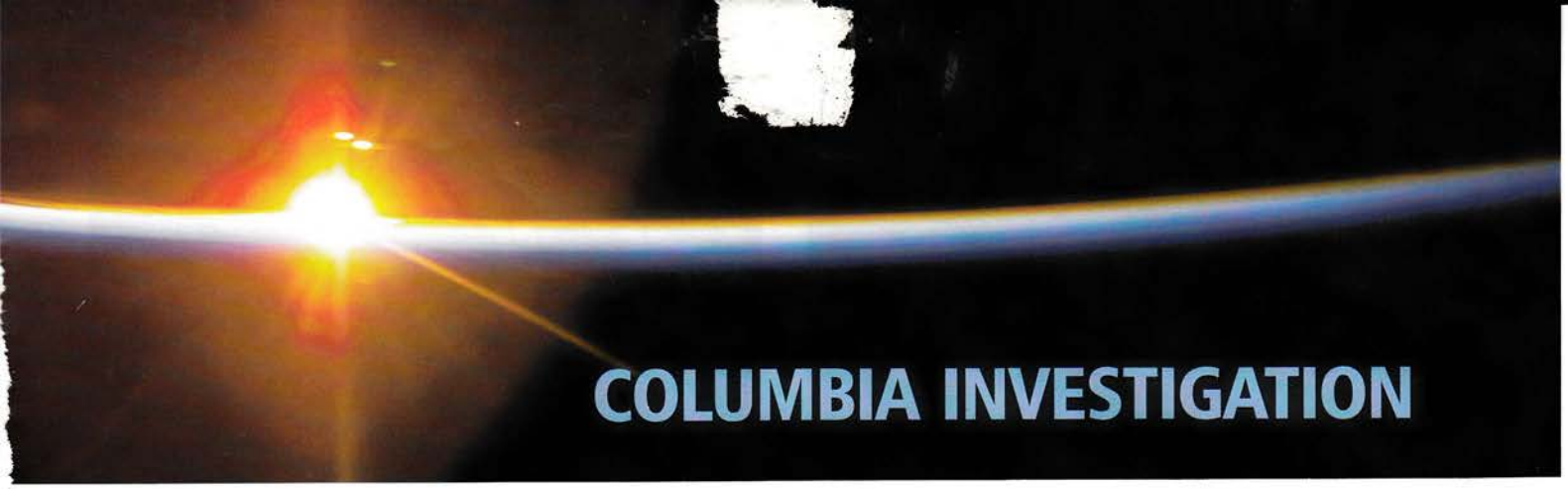


Piecing together the evidence

by Joel W. Powell

When Space Shuttle Columbia fell from the Texas skies on 1 February 2003, NASA had a ready-made facility at Kennedy Space Center to bring the shattered remains of the orbiter to be examined and analyzed. Located just off the threshold of Runway 33 at the Shuttle Landing Facility (where Columbia was targetted to land that morning) is the Reusable Launch Vehicle Hanger completed in 2001. Intended to support flight operations of the experimental X-33 and X-37 space vehicles, the hanger had been mostly idle since the cancellation of the two RLV programmes. NASA wasted little time appropriating the under-utilised 50,000 square foot facility to house the Shuttle debris, moving in right after the KSC memorial service at the SLF runway on 7 February.

An incredible profusion of wreckage was transported by searchers from the crash sites in Texas and Louisiana to the debris collection and evaluation site at Barksdale Air Force Base in Shreveport, LA. Residents along Columbia's flight path on that awful morning - in towns with names like Palestine, Lufkin and Nacogdoches - awoke to the sounds of sonic booms and metallic debris crashing to Earth. Strewn across the landscape were the shattered remains of Columbia: 25 nearly-intact gas and propellant storage bottles, scattered shards of the fuselage and wings, innumerable scraps of Shuttle tiles. An astronaut's helmet, a stray STS-107 mission patch from the cabin and the cockpit window frames were all poignant reminders of seven lost souls.

The first truckloads of Columbia debris shipped from Barksdale arrived at the RLV hanger on 12 February. KSC personnel quickly began arraying the wreckage on a 188 X 166 foot grid marked out in yellow on the hanger floor. The debris was laid out according to its location on the orbiter, with fuselage pieces in the centre of the floor and the wings (tiles and leading edge pieces) on either side of the hanger.

Aside from the window frames and gas storage bottles, the most recognisable pieces were the three orbiter landing gear (complete with all six tyres), airlock hatches and tunnel frames and the RCS thruster panel from the right side of the orbiter's forward fuselage. The heavy turbo machinery from the Shuttle main engines were dug out of the ground in Louisiana, but aside from some stiffening rings the nozzles were not located.

Items from the cockpit were stored separately in a locked-off area at the front of the hanger. These included personal items, crew equipment and a number of video tapes and exposed photographic film (later developed and released to the public) that was found amoung the wreckage. Less than half of the crew cabin was actually recovered. Several of the scientific experiments located in the SpaceHab module were found intact in the debris field and NASA made them available to the principal investigators for analysis.

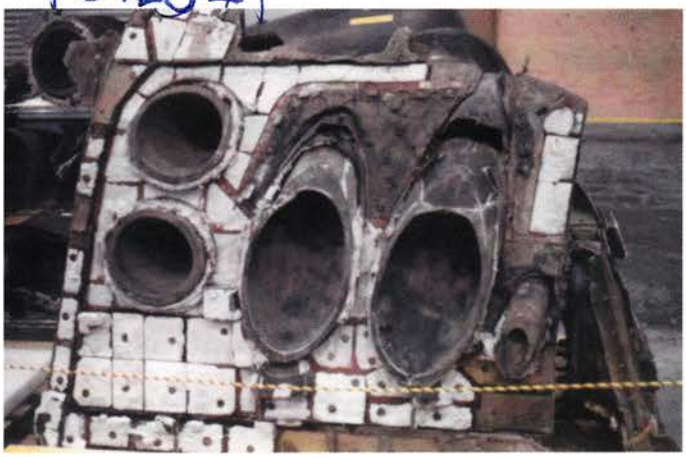
Tyres from the left landing gear appeared to be ruptured, but researchers could not determine whether the tyres burst during entry or after breakup of the orbiter. The shattered nose of the orbiter with the broken carbon-carbon nose cap was positioned with the forward fuselage debris, still shrink-wrapped to keep the pieces together. It did not appear that the wrapping had been removed since the nose section had arrived at the hanger.

Reconstruction

With a left wing debris strike during liftoff

The STS-107 crew members strike a 'flying' pose for their traditional in-flight crew portrait in the Spacehab Research Double Module (RDM) aboard the Space Shuttle Columbia. This picture was on a roll of unprocessed film later recovered by searchers from the debris and recently released by NASA.

The forward cockpit window frames of Columbia, with high pressure gas storage bottles and thruster propellant tanks in the background.



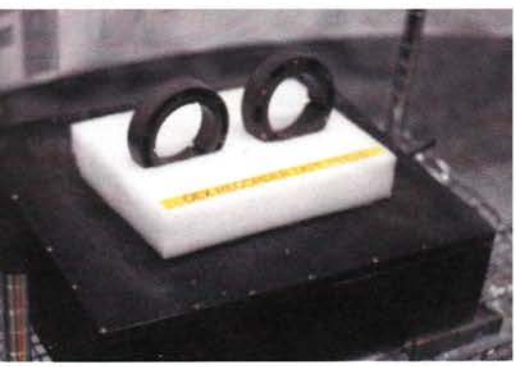
One of the largest recognisable pieces of Columbia recovered was this panel from the forward reaction control system with five intact thruster nozzles.

considered by NASA to be the leading candidate for the cause of the accident, investigators decided early on to only attempt reconstructing portions of the left wing. The rest of the orbiter was so badly fragmented that there was scarcely any part of the structure that could be pieced back together (in contrast with Challenger) despite the nearly 84,000 pieces of debris collected by searchers. Only 38 percent of the orbiter by weight was retrieved: a total of 84,900 pounds, for an average of just over one pound per fragment. Most of the pieces were tiny scraps of metal or broken bits of tile.

Initially the search teams were discouraged by the lack of debris found from the left wing of Columbia, but as the weeks passed more and more pieces of the reinforced carbon-carbon (RCC) leading edge panels from both wings turned up in the ground search. Eventually all forty-four U-shaped RCC panels from both wings were recovered, either in whole or in part. Most of the relatively intact leading edge panels were found broken in half. Identification of the individual panels were made by technicians who worked on the orbiters: since each segment was unique, the pieces were identified by their shapes relative to their neighbours, like a jigsaw puzzle.

Retrieval of the orbiter experiments data recorder was one of the luckiest breaks of the debris recovery effort - it was the only avionics box from Columbia to survive intact.

All photos: Joel W. Powell unless otherwise indicated



Working from unenhanced ground launch photography in the first weeks after the accident, NASA investigators originally pinpointed the breach of the left wing on or near RCC panel number 6. Furthur analysis of the launch video suggested an impact at the T-seal junction of RCC panel 9, but when the investigators discovered that left wing panels 8 and 9 were included in the recovered wreckage, it was clear from the pattern of hot gas erosion that the lower portion of panel 8 was the site of the impact (see photo).

The adjoining edge of panel 9 was also scoured to a knife-edge by hot plasma that penetrated the wing. RCC panel 8, which had broken into eight pieces, was not found until about three months after the accident. The pieces were strewn over a 120 mile baseline located between the towns of Ennis and Alto, Texas. The debris from panels 8 and 9 were found the furthest west, indicating that they separated from the left wing first and probably represented the the site of the original impact.

The reconstruction team designed and built a transparent lucite framework to piece back together the leading edge of the left wing up to panel 13. This arrangement allowed the recovered mounting hardware to be located in the correct positions relative to each RCC panel, permitting investigators to trace the path of hot gas inside the leading edge. Technicians laser-imaged the left wing hardware so that a virtual 3-D reconstruction of the wing could be produced and graphic representations printed.

Forensic analysis

Analysts found molten slag deposits on the inside surface of panel 8 and the remains of panel 9: deposits of steel that formed as the 3000F hot gas melted stainless steel attachments of the RCC panels behind the area of the breach; inconel deposits from melted inconel alloy (spanner beams) and aluminium from the structure of the wing itself. Panels 8 and 9 had the greatest concentration of slag deposits, one of the most compelling indications that the breach occurred at that location.

Early in the investigation the reconstruction team discovered that recovered tiles from Columbia were covered by a thin layer of slag, which turned out to be droplets of molten aluminium that was sprayed off the disintegrating left wing. Such was the case with the recovered portion of the left OMS pod leading edge that was pitted and scarred from the heavy flow of molten metal off the wing. Investigators deduced that the molten particles were responsible for many of the disruptions (drop-outs) in the radio link from the orbiter, the particles randomly scattering signals aimed at the TDRS data relay satellite.

It took an incredible stroke of luck to provide investigators with the additional data that they needed to back up the finding of a left wing breach at RCC panel 8. Searchers attempted to find the vehicle's data recorder (from the lower avionics deck) by looking in the same general area where other avionics boxes had been recovered. The grid search paid off on 19 March when the battered Orbiter Experiments (OEX) recorder box was found near Hemphill, Texas. None of the other avionics boxes were recovered intact, but miraculously the OEX mechanism and tape proved to be in pristine condition when the lid of the box was pried open.

Early fears that the tape was somehow damaged by reentry plasma proved groundless when the tape was reconditioned by the vendor and was eventually played back and copied by KSC technicians. Not only was the tape intact with the record from some 721 sensors on Columbia, but the data extended within four seconds of breakup, forty seconds past the loss of the limited amount of telemetry data radioed to Earth during the orbiter's final moments.

Data recorded on the OEX tape during reentry helped corroborate the foam impact scenario at RCC panel 8. A strain guage behind panel 9

This is the largest piece of the payload bay doors to be recovered, still covered with part of the flexible thermal blanket.

This fragment is from the leading edge of the left hand OMS pod of Columbia, deeply scored and pitted from plasma flowing off the damaged left wing.

registered the first effects of the breach only four-and-a-half minutes after entry interface (EI) occurred at 8:44:09 am Houston time. Twenty seconds later an adjacent temperature sensor began registering the first indications of rising temperatures in the wing as hot gas was entering the breach.

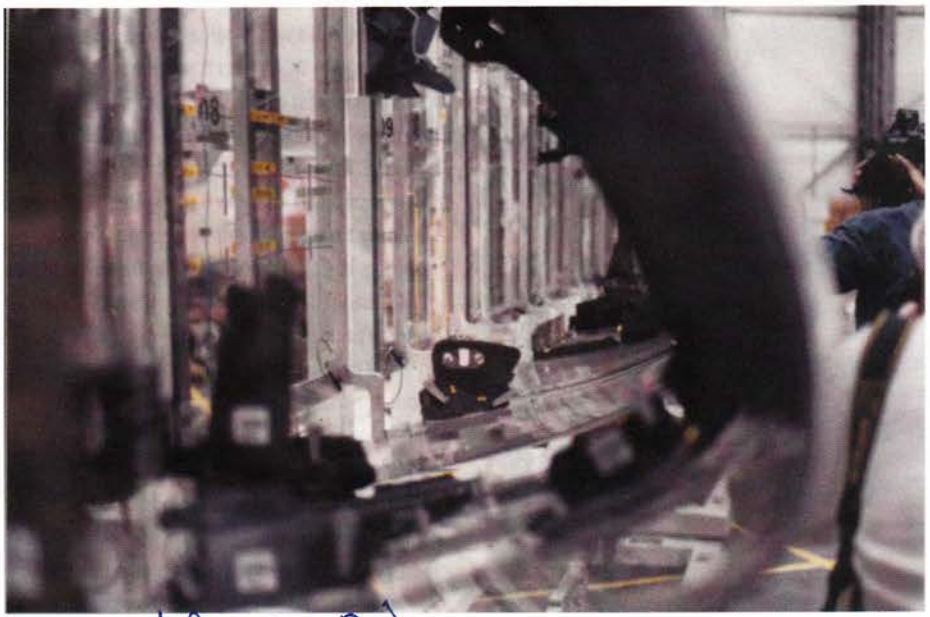
The first indications of trouble showed up in Columbia's telemetry at 8:52:17 am as a small increase in the left brake line temperature after the internal wing spar was breached by hot gas. The orbiter had not yet crossed the California coastline. Hot gas entered the left wheel well at 8:54:00 am and began impinging upon the landing gear strut. Eventually most of the sensors in the left wing went off-line as their wiring bundles routed around the wheel well burned through as the hot gas ate its way into the aluminium wing structure. Aerodynamic breakup occurred at 9:00:18 am and Columbia was lost.

Smoking gun

Final confirmation of the wing breach scenario came in dramatic fashion on 7 July 2003 when researchers at the Southwest Research Institute (San Antonio, Texas) shot a piece of external tank foam at actual shuttle RCC panels. The test was an exact duplication of the conditions 81.7 seconds after liftoff when a 1200 cubic inch segment of foam separated from the left-hand (-Y) bipod ramp where the orbiter is attached to the external tank. The foam decelerated in the slipstream of the Shuttle and impacted the left wing leading edge 0.2 second later.

A nitrogen-powered gas gun fired a 1.67 pound piece of foam at the leading edge test

RCC Carbon panels from the area of the breach in Columbia's left wing were mounted in lucite frameworks to facilitate the reconstruction process. This is the inside of the framwork where RCC mounting brackets are visible.



The left-hand main landing gear from Columbia with one of the shredded tyres with right-hand main gear tyres in the background.

Members of the Columbia Reconstruction Project Team look over pieces of Columbia RCC panels on the floor of the RLV Hangar. T-seal at far right. NASA

article at the estimated 22 degree angle of impact deduced from launch films, and disintegrated upon contact with the panel 8 on the test rig at a velocity of 777 feet per second. A hole measuring 16 x 17 inches was smashed in the underside of the panel taken from the orbiter Atlantis, and the surrounding surface of the panel was badly cracked. The impact also broke one of the lugs (bolt holes) that fastened one of the so-called T-seal expansion joints fitted on either side of each RCC panel (see below). The force of impact during the test exceeded the design strength of reinforced carbon-carbon by 50 percent or more.

Two fragments of the outer surface were RCC panel 8 from Columbia's left wing. The breach occurred on the bottom (missing) portion. The holes are where samples were removed for analysis.

forced into the internal cavity of the leading edge during the test, which helps to explain the mysterious object that separated from Columbia one day after launch. The object was detected by Air Force tracking radars but was not identified until after the accident. A loose piece (or pieces) of the RCC outer surface measuring greater than 90 square inches was the only material that matched the radar cross section of object 90626 that floated away from Columbia after a yaw attitude manoeuvre on 17 January.

The Columbia investigators believe that a fragment of the RCC panel remained within the hole after impact, and the manoeuvre dislodged it from the orbiter at 1517 UT. It reentered the atmosphere without being observed two days later. Due to a number of factors, the investigative board believes the hole caused by the foam impact on Columbia was smaller than observed in the impact test. They believe the actual impact site on Columbia was more likely about 10 inches square (compared to 16 X 17 inches in the test), given the size of the object that separated on day two (see above) and the likelihood that Columbia would not have lasted as long as it did with a larger breach in the wing.

Damage to RCC panel 8 resulting from the foam impact test also helped to explain two other unusual phenomena associated with Columbia's breakup. The cracked surface of the RCC panel in the test suggests that the flaming debris observed shedding from the orbiter by amateur Shuttle watchers in California was in fact fractured pieces of RCC panel 8 that broke away from the wing 10 minutes prior to breakup.

The T-seal attachment lug that was broken during the foam impact test closely duplicated damage to the T-seal segment between panels 8 and 9 found by searchers in Texas. The fractured rib of the recovered T-seal was scored by hot gases in an unusual pattern that could only be explained if the T-seal rocked back and forth on the broken lug during entry, producing an intermittent flow of hot gas past the rib structure. This intermittent gap in the T-seal alone could have caused the loss of Columbia on that terrible morning.

The sequence of events was patiently deduced by the 150 person reconstruction team at Kennedy Space Center using the telemetry data transmitted to Earth during the reentry, measurements preserved by the OEX data recorder and the physical traces on the recovered pieces of the left wing RCC panels. Without the physical evidence collected from the scrublands of Texas, the exact cause of the Columbia tragedy may never have been determined with any degree of certainty.

The herculean task of recovering the wreckage strewn over a 239 mile corridor centered on Lufkin, Texas was accomplished by a team of 16,500 searchers. A total of 1.5 million man-hours was expended in the search and recovery effort from early February through May. The greatest accomplishments of the searchers included the recovery of the OEX data recorder with all its data intact, and retrieval of all the RCC leading edge panels (in pieces or intact) from both wings. The overall success of the investigation can be directly attributed to the efforts of these volunteer searchers.

What has become of the wreckage now that the investigation has been concluded? After identification of the debris was completed on 30 May, there was a final media walkthrough on 4 June (which the author attended) followed by a two month period where KSC employees could view the wreckage to pay their respects and investigators would continue to have access to the debris. In late August the material was crated and transferred by NASA to a permanent 10,000 square foot storage location on the 16th level of the Vehicle Assembly Building. The space agency has announced that the material will be made available to researchers in the areas of metallurgy, aerodynamics and reentry studies, unlike the controversial disposition of the Challenger wreckage which was sealed in an old Minuteman missile silo at Cape Canaveral.

CNN : 08 OKTOBER 2003.

SIMPLE BRUSH MAYH SOLVE SHUTTLE PROBLEM.

WASHINGTON - Repairing the space shuttle heat shield in orbit may be simpler than NASA once thought, requiring one of the most basic of home repair items -- a foam paint brush. NASA administrator Sean O'Keefe said that engineers studying ways for spacewalking astronauts to fix a hole in the panels that protect the space shuttle from re-entry heat have found that an ordinary foam paint brush could be used to spread a special compound while the craft is in orbit. return the space shuttle to orbit in the wake of the February 1 accident that destroyed Columbia and killed seven astronauts. The Columbia Accident Investigation Board determined that the shuttle was destroyed when superheated air entered a hole in the heat shield on the leading edge of the left wing and melted internal aluminum supports. The CAIB called for the space agency to develop a way for spacewalking astronauts to repair such heat shield damage. Astronauts on Columbia and engineers in Mission Control were not aware of the extent of damage to the shuttle wing, but officials said that, in any case, there was no equipment on board the orbiting shuttle to patch the wing even if the problem was recognized. O'Keefe, at a news conference on Wednesday, said that engineers had looked at the problem prior to the Columbia accident and concluded that it would require highly technical tools and a very difficult spacewalk. For that reason, no repair kit was ever flown on the shuttle. But with a fresh look at the problem, he said, engineers have determined that patching a heat shield hole may be "elegantly simple." He said experts have developed an applicator that would squirt two compounds into a heat shield hole. The compounds would chemically combine to make a strong patch that would expand when heated by the friction of re-entry, O'Keefe said. "The easiest way to spread the compound without having it stick to the instrument turns out to be a simple thing -- a foam brush," he said. Such a brush is commonly available at hardware and paint stores and is routinely used by millions of homeowners when painting their houses. For spacecraft repair, said O'Keefe, the foam brush is "an elegant piece of hardware." O'Keefe said the compound, which he did not identify, has been tested with an electrical arc at 3,000 degrees, the temperature encountered during shuttle re-entry. Spacesuited astronauts, he said, are testing application of the compound in a zero-gravity airplane, a KC135 that can be flown in a way to give a few seconds of relative weightlessness. The administrator said the patching technique is still being refined, but the early studies show the problem may be relatively easy to solve.

81215

SPACE.COM : 09 OKTOBER 2003.

BEST SHUTTLE REPAIR TOOL : WAL-MART PAINT BRUSH.

81216

WASHINGTON - A simple foam paint brush that costs only pennies at hardware stores could be an essential tool in returning the space shuttle to orbit, NASA's administrator said Wednesday. Space agency engineers found that the brush may be just what astronauts need to spread a patching compound on a space shuttle's damaged heat shield while the craft is in orbit. "This thing turns out to be one of the most valuable tools we could have invented," said Sean O'Keefe, head of the National Aeronautics and Space Administration. "We're going to buy it at Wal-Mart. We're not going to ask the Defense Department to requisition it out of stock." A clerk at a Washington-area hardware store said a 1-inch foam brush sells for 49 cents and a 2-inch one cost 99 cents. Designing and testing a way to repair damage in the shuttle's heat shield is an important part of NASA's efforts to return the space shuttle to orbit after the Feb. 1 accident that destroyed Columbia and killed seven astronauts. The Columbia Accident Investigation Board determined that the shuttle broke apart when superheated air entered a hole in the heat shield on the leading edge of the left wing and melted internal aluminum supports. The accident has led the agency to ground the shuttle fleet. Astronauts on Columbia and engineers in Mission Control were not aware of the extent of damage to the shuttle wing. But officials said that, in any case, there was no equipment on the shuttle to patch the wing even if the problem were recognized. Officials at the Johnson Space Center said the patching compound now under consideration could be used only for the part of the heat shield composed of lightweight tiles. The nose of the shuttle and the leading edge of the wings are covered with panels of a different material, reinforced carbon-carbon. It was a break in a carbon-carbon panel that led to the loss of Columbia. Kelly Humphries, a spokesman at the space center, said that repairing the carbon-carbon panels is more difficult and would require methods different from the tile repair. Among the techniques under consideration for are a patch that could be internally bolted in place, an adhesive patch, or an overwrap that would envelop a heat shield breach. Before returning to the shuttle to space, the investigation board said NASA must develop a way for astronauts to fix heat shield damage while the craft is in orbit. Such work would require a difficult spacewalk. An astronaut would have to maneuver in weightlessness and reach gouges or holes on the heat shield on the outside of the shuttle. The damage would require patching with a substance that could withstand the 3,000-degree heat of re-entry. O'Keefe said NASA earlier had studied this kind of repair and "it was deemed ... to be too difficult to achieve and therefore not workable." But after the Columbia accident and given the mandate from the investigation board, NASA engineers took a fresh look and found possible solutions, he said. To repair the heat shield, O'Keefe said engineers have found a sealant that is formed when two compounds are mixed together. Tests showed that the combined compound expanded when heated. This led to a plan to "underfill" a hole and then let the heat of re-entry swell the patch and seal the hole. Once they had a compound, the engineers then had to find a way for a spacewalking astronaut to apply the material while wearing a bulky space suit, gloves and a bubble helmet, O'Keefe said. Experts looked at a variety of sophisticated tools made from exotic materials, he said. They settled on what he called "an elegant piece of sophisticated hardware" -- a foam paint brush with a wooden handle. O'Keefe said the foam brush avoided the problem of sticking to the sealant while the sealant was being spread in the hole. Other, more sophisticated tools became mired in the compound, he said. "This may not ultimately be the option, but it is the one we are looking at now," said O'Keefe. More testing is planned before the final patching system is developed, he said.

Onderzoeksrapport Columbia-ramp klaar

Zeven maanden heeft de onderzoekscommissie nodig gehad om tot een eindoordeel te komen hoe het nu precies mogelijk was dat de Space Shuttle Columbia tijdens haar terugkeer naar de aarde op 1 februari voor een groot deel verbrandde en daarna neerstortte in Texas. Al snel was duidelijk dat het tijdens de lancering op 16 januari fout ging. Een stuk afgebroken isolatieschuim van de grote brandstoftank raakte de linkervleugel van Columbia en sloeg een gat in de vleugelrand. In het eindrapport stelt de commissie de vraag waarom hogere leidinggevenden bij NASA niets deden met die gegevens. Ook worden er een aantal aanbevelingen gedaan die nodig zijn om de Space Shuttle weer te kunnen laten vliegen.

8121?

Door JACQUES E. VAN OENE

De onderzoekscommissie die onder leiding stond van Harold Gehman doet in haar eindrapport 29 aanbevelingen, waarvan er 15 moeten worden uitgevoerd voor de Space Shuttle weer "veilig" kan en mag vliegen. NASA had de stille hoop om in het voorjaar van 2004 weer een Shuttle de ruimte in te sturen, maar de belangrijkste aanbeveling die het rapport doet, maakt dat hoogst twijfelachtig.

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NASA moet een manier zien te vinden om beschadigde hittewerende tegels en RCC-panelen van de vleugels te repareren of indien mogelijk te vervangen als de Space Shuttle in de ruimte is. In het repareren van de tegels aan de onderzijde van de Shuttle voorziet de NASA niet al te veel problemen: deze techniek kan binnen een paar maanden gereed zijn en dan kunnen astronauten er op gaan trainen.

Maar het vervangen of repareren van de RCC panelen op de vleugelranden van de Space Shuttle geeft meer problemen. Het materiaal moet bestand zijn tegen de enorme hitte die tijdens de terugkeer naar aarde vrijkomt. Het vinden van een goede oplossing daarvoor geeft nog de grootste problemen.

De andere aanbevelingen

Van de vijftien aanbevelingen zijn dit verder de belangrijkste:

Onderzoeksvoorzitter Harold Gehman.

* NASA moet zo veel mogelijk zien te voorkomen dat er isolatiemateriaal van de grote brandstoftank los kan komen tijdens te lancering.

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* Een Shuttle-lancering moet tot in het kleinste detail gefilmd en gefotografeerd worden. Er moeten ook camera's op de grote brandstoftank komen

* De Space Shuttle moet, terwijl ze in de ruimte is, gefotografeerd worden om te kunnen beoordelen of ze beschadigd is. Bij ISS vluchten kan dat vanuit het ruimtestation gedaan worden.

* De Space Shuttle mag voortaan alleen nog maar bij daglicht gelanceerd worden. Om beter te kunnen zien of er bij de start iets fout gaat.

* NASA moet onderzoeken of het mogelijk is om een bemanning die in een beschadigde Shuttle zit, veilig terug naar aarde te halen.

Challenger

Na de ramp met de Space Shuttle Challenger in 1986 werd er ook een uitgebreid rapport opgesteld. Daarin vroeg men zich af waarom de lancering die koude januari-dag was doorgezet en er niet was geluisterd naar een aantal mensen op de werkvloer die zeiden dat de O-ringen van de opduwraketten niet tegen kou bestand waren. Nu, 17 jaar later, speelt opnieuw de vraag waarom werd er niets gedaan tijdens de 16 dagen dat de Columbia in de ruimte was met het gegeven dat de Shuttle aan de onderkant beschadigd zou kunnen zijn en dat de terugkeer wel eens een fatale afloop kon hebben.

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Gelijk na het zien van filmbeelden van de lancering was al duidelijk dat de vleugel geraakt was door iets dat van de brandstoftank afkomstig was. In e-mails vroegen medewerkers van NASA zich al af wat voor een gevolgen dit kon hebben. Sommige vreesden al voor een fatale afloop. De commissie stelt in haar eindrapport dat er het nodige moet veranderen binnen NASA om er voor te zorgen dat de communicatie van werknemers naar chefs en directeuren beter gaat verlopen en dat er na Challenger niet veel is veranderd.

Jonathan Clark, de man van de omgekomen Laurel Clark, zei na het lezen van het rapport: „Ze moeten nu maar eens goed kijken bij NASA of ze

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Een technicus meet het gapende gat dat op 7 juli in een testvleugel is ontstaan. Zo moet ook het gat in de vleugelrand van het ruimteveer Columbia er uit hebben gezien. Het 'mysterieuze object' dat in de ruimte bij het ruimteveer werd gezien, was waarschijnlijk een brokstuk dat uit dit gat zweefde. 81221

deze keer wel wat gaan leren en doen, het komt op mij over dat je de "O-ring" kunt vervangen door "kapotte vleugel" en "Challenger" door "Columbia".

Het lot van de bemanning

Het eindrapport gaat ook in op de laatste minuten van de bemanning van Columbia en hoe het hun verging toen de Shuttle uiteenviel. Uit de vrijgegeven videobeelden van de terugkeer waarop de cockpit te zien is en de lichamen van de bemanning, blijkt dat de astronauten zich niet hebben gehouden aan de voorgeschreven procedures die gelden voor de terugkeer.

Voordat de Shuttle aan haar terugkeer begint, moet de bemanning de fel gekleurde oranje ruimtepakken aantrekken en volledig luchtdicht afsluiten. Drie astronauten van de Columbia hadden nog geen handschoenen aan en één droeg zelfs zijn helm nog niet op het moment dat het noodlot toesloeg. Maar dit heeft niet bijgedragen aan een eventuele kans op overleving. 81222

Het gedeelte waarin de astronauten zich bevonden, is door de zeer hoge temperatuur afgebroken van de overige delen van Columbia. Binnen in de cabine heeft zich geen explosie voorgedaan door eventuele overdruk, zoals eerder werd vermoed. Het compleet uiteen vallen in kleinere stukken door de snelheid en de hitte heeft ongeveer 24 seconden geduurd. De module bevond zich op dat moment op ongeveer 55 kilometer hoogte.

De tijd van overlijden van de bemanning moet na 15:00.19 uur Nederlandse tijd hebben gelegen. De bemanning is omgekomen door zuurstoftekort en de zeer zware verwondingen, opgelopen door dat de crew module geen bescherming meer kon bieden. 81223

De steeds groter wordende snelheid waarmee de crew module richting aarde viel, heeft niet bijgedragen aan de dood van de bemanning. Het is dus niet helmaal bekend wat de bemanning precies heeft meegekregen van het uiteenvallen van de Shuttle.

STS-114

Nu het onderzoek is afgesloten, kan NASA werken aan een terugkeer naar de ruimte van de drie overgebleven ruimteveren. NASA heeft een voorlopig lanceerschema gemaakt. Daarop valt te zien dat Space Shuttle Atlantis op 11 maart 2004 gelanceerd gaat worden. De periode om de Shuttle in daglicht naar ISS te sturen loopt tot 6 april 2004 daarna kan op zijn vroegst half mei een nieuwe poging gedaan worden.

Deze datum is zeer onwaarschijnlijk omdat het maar de vraag is of er voor die tijd een oplossing gevonden is om de RCC-panelen te repareren. Sommige technici zeggen dat er op zijn vroegst in de herfst van 2004 weer gevlogen kan worden. ★ 81224

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Veiligheidspanel Nasa treedt af

Dirk van Delft

Het negenkoppige veiligheidspanel van de Nasa is afgelopen dinsdag in zijn geheel afgetreden, aldus de *New York Times*. Het Aerospace Safety Advisory Panel, in 1967 ingesteld na de brand in de Apollo 1 (die drie astronauten het leven kostte), was de afgelopen weken zwaar onder vuur komen te liggen. Een Senaatscommissie verweet het panel problemen die de weg effenden voor de ramp met spaceshuttle Columbia niet te hebben onderkend. En het Columbia-onderzoeksteam noemde het panel in zijn eind augustus verschenen eindrapport 'onafhankelijk, maar veelal weinig invloedrijk'.

Weliswaar klaagde het panel in 1995 dat de Nasa de spaceshuttle als volwassen beschouwde in plaats van als een toestel dat nog altijd in de ontwikkelfase verkeerde, en dat 'die zelfgenoegzame houding ernstige ongelukken in de hand kon werken', maar dat haalde weinig uit. Het Columbia-onderzoeksteam wees juist die zelfgenoegzaamheid aan als de diepere oorzaak achter de ramp van 1 februari. Sommige panelleden klaagden over gebrek aan onafhankelijkheid, omdat stafleden in dienst waren bij de Nasa. Tegenover de *New York Times* verklaarde panelvoorzitter Shirley McCarty, een luchtvaart-consultant, dat de leden zich 'zwaar gefrustreerd' voelden.

Kort na het ongeluk met de Columbia had het panel op zijn jaarbijeenkomst een ontsnappingsvoorziening voor shuttlebemanningen bepleit. Ook zou de *officer* die tijdens shuttlevluchten de veiligheid bewaakte een onafhankelijker positie moeten innemen. Maar de Nasa toonde zich niet ontvankelijk, aldus McCarty, wat de effectiviteit van het panel niet ten goede kwam. De Senaatscommissie heeft zich intussen uitgesproken voor een reorganisatie van het veiligheidspanel. Een nieuw team van erkende experts op het gebied van veiligheid, organisatie en techniek, afkomstig uit de industrie en de academische wereld, zou met een nieuwe opdracht aan de slag moeten. ●

● ***Band van de verongelukte Columbia, gevonden in Texas.***

FOTO NASA

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NRC Handelsblad:
27-09-2003

FLORIDA TODAY : 03 OKTOBER 2003.

SHUTTLE FLIGHT MOVES BACK. TECHNICAL HURDLES SLOW RETURN.

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CAPE CANAVERAL - NASA's first post-Columbia shuttle mission is being pushed back to September. Its second won't launch before November 2004, and agency officials said Friday it would be a challenge to avoid a delay until next year or even 2005. "I can almost guarantee that this is going to be a long, uphill climb back to return to flight," NASA space flight chief William Readdy said. "But I'll also guarantee that we're getting an awful lot smarter about this, and we're going to come back stronger and safer as a result." Readdy's comments followed a NASA meeting aimed at gauging the agency's ability to return its shuttle fleet to service by mid-July. Technical hurdles, however, prompted managers to target NASA's next mission for launch between Sept. 12 and Oct. 10 2004. A second flight is planned during a three-day window that opens Nov. 15 2004. Both missions to the International Space Station are intended to demonstrate techniques for inspecting and repairing shuttle thermal tiles and wing panels in orbit. An accident investigation board recommended the development of those capabilities after the Feb. 1 Columbia disaster, which killed seven astronauts. The investigators found a piece of shuttle external tank foam struck the orbiter's left wing, opening up a breach that allowed hot gasses to tear the ship apart during atmospheric re-entry. They also found NASA had no ability to inspect or repair that type of damage in orbit. Readdy and NASA shuttle program manager William Parsons said the new target dates will give engineers time to develop: A boom equipped with cameras and laser sensors. It will be used to inspect shuttle tiles and wing panels for damage. A technique for repairing shuttle wing panels. Methods under consideration possibly could have fixed the type of 6- to 10-inch hole that led to Columbia's demise. Managers also will decide next week the extent of inspections to the nosecap of Atlantis, which is slated to fly next. Corrosion found beneath Discovery's nosecap might prompt an extensive inspection on its sister ship. The new target dates represent NASA's last chance to return shuttles to space in 2004. New daytime launch restrictions limit NASA to the month-long opportunity that opens Sept. 12 and then the three-day window in November. Beyond that, NASA will have a three-day opportunity in January 2005. No opportunities are available in February and March of 2005.

22366

SPACE.COM : 09 OKTOBER 2003

CHASE PLANES COULD ALLOW NIGHT SHUTTLE LAUNCHES

CAPE CANAVERAL - A pair of WB-57F chase planes equipped with sophisticated imaging systems might be the ticket for NASA to resume launching space shuttles at night, agency officials said Wednesday. Two high-altitude research planes would fly on either side of a shuttle climbing to orbit, their cameras trained on the forward third of the shuttle. That section can't be seen by ground-based cameras during night launches because of the bright glow from the solid rocket booster exhaust. The brilliant plume, however, does provide plenty of light for aerial cameras to see the top of the shuttle during the first two minutes of flight -- at least that's what officials hope to find out, said Robert Page, NASA's manager in charge of improving the tracking camera capabilities at the Kennedy Space Center. "We've got a lot of details to work out, especially with the Eastern Range and how close we can fly to the shuttle, but we're extremely hopeful that it will work," Page said. The Columbia Accident Investigation Board (CAIB) in its final report called upon NASA to provide at least three useful views of a shuttle launch and modernize its image analysis capabilities so that mission managers will have a clearer picture, literally, of any debris falling from the external tank that might damage the shuttle. It was a 1.7-pound chunk of external tank foam insulation that fell during launch and struck Columbia's left wing, opening a hole in the leading edge that allowed hot gases inside during the Feb. 1 re-entry to trigger the disaster that killed seven astronauts. Although tracking cameras did capture the shedding debris, officials concluded the debris didn't pose a threat to the mission, in part because a quick analysis of the film could not conclusively prove there should be a concern. The CAIB found fault with that reasoning on a variety of levels and said that additional views and image analysis capability were crucial before a return to flight. Until then, the board said, only daylight launches should be planned. In the meantime, NASA is modernizing its image analysis laboratory at KSC. So far some $3.2 million has been spent on new computers, software and imaging systems. Engineers are upgrading from relying on a noisy 35 mm film projector that is difficult to work with -- an older unit that is the only one KSC has -- to being able to scan the film into a computer and digitally manipulate the image on giant projection screens. The systems are similar to the digital equipment Hollywood editors use and is "state of the art," said Armando Oliu, head of KSC's image analysis team, and will allow the group to study the films in greater detail. With a mandate of "three useful views" no matter the weather conditions or path the shuttle is flying to orbit, KSC is working with the Air Force to add at least 11 new cameras at sites all over Florida's Space Coast. The cameras are categorized as short, medium or long-range trackers and each is responsible for following the shuttle during a certain phase of flight. Each category uses different types of lenses and film speeds. According to Page, NASA plans to increase the number of short-range cameras from four to six, medium-range cameras from five to seven, and long-range trackers from four to 10 -- including adding a camera 38 miles to the north at Ponce Inlet that will be in an especially good position to see solid rocket booster separation during space station missions.

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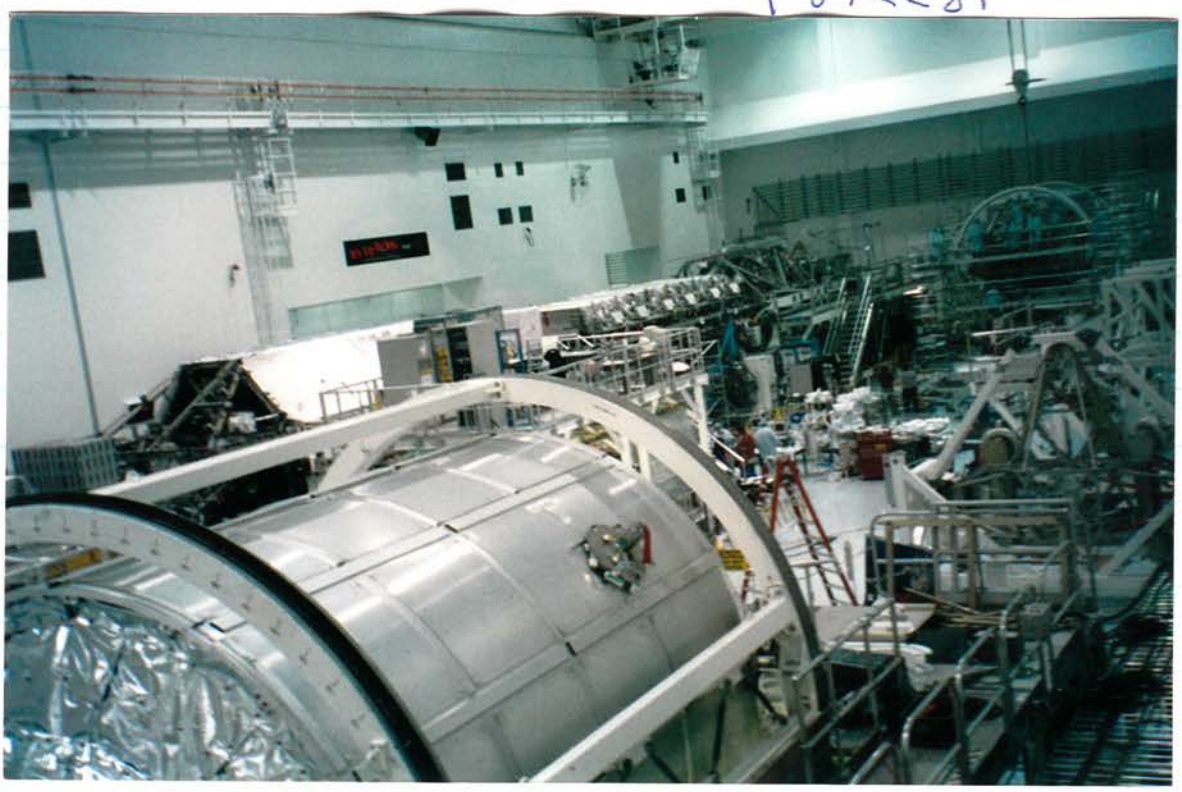

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COLUMBIA INVESTIGATION

Shuttle mission to demo new safety features

Compiled by Tim Furniss

The Space Shuttle Atlantis will be launched on mission STS-114, probably next summer, on a developmental test flight to demonstrate new safety features recommended by the Columbia Accident Investigation Board.

Although March 2004 is given as a target date, it is unlikely to be met, said NASA officials. "We will be safety-driven, not schedule-driven", said Bill Readdy, NASA's Human Space Flight chief.

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The mission will carry a six or seven person crew and will visit the International Space Station (ISS), where some repair work is required. The mission lasting about 11 days.
It will implement the 15 return-to-flight recommendations made by the CAIB.

Atlantis will not carry an ISS Expedition Crew, however, which means that the Russian Soyuz TMA craft will continue to be used for crew transfers, probably until late 2004.

The STS-114 mission will demonstrate methods to eradicate shedding of foam from the external tank during launch, including the elimination of the foam ramp in the bipod area and replacing it with electric heaters. New leading-edge protection panels on the orbiter and in-orbit repair techniques during EVAs will be assessed.

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The mission will also demonstrate improved camera and laser coverage during the launch, solid rocket booster separation and ascent into orbit; and of the orbiter in space, using the remote manipulator system, equipped with an extension boom. The orbiter will also be imaged from the ISS.

Space Shuttle chief, Bill Parsons, said: "Our first line of defense is don't have any debris come off and strike the shuttle. The second line is to have inspection techniques and repair capabilities so we can come home safely."

The mission will also attempt to mend the flawed NASA culture that stifled communications about potential flaws on Columbia during STS-107.

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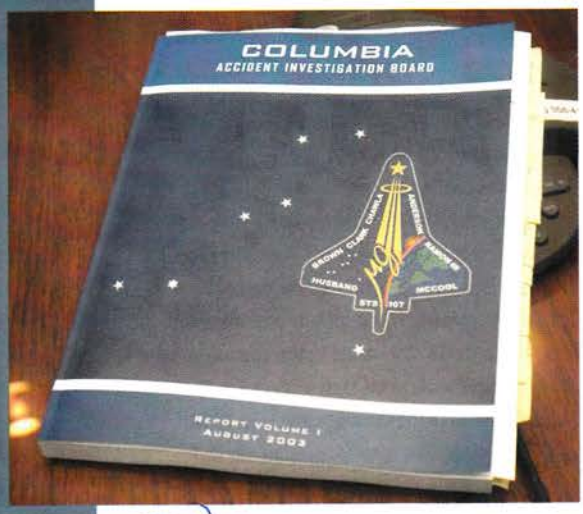
The cost of the safety programme and the demonstration mission has not been revealed.

NASA will be assisted in the Shuttle recovery programme by the independent advisory Return to Flight Task Group led by the veteren Gemini and Apollo astronaut Tom Stafford and Richard Covey, a former Shuttle pilot and commander.

Board pins blame on NASA culture

NASA was severely criticised by the Columbia Accident Investigation Board (CAIB) in its report into the STS-107 re-entry accident which killed seven astronauts and destroyed the orbiter on 1 February. The report was released on 26 August and in making 29 recommendations for corrective actions, the CAIB's criticism is constructive and understanding of the nature of the agency and the pressures it has been under from many areas. The CAIB says that the Space Shuttle cannot be operated safely for many more years and that it should be replaced as soon as possible, initially by an Orbital Space Plane for crew transportation.



The accident was not an anomalous, random event "but rather likely rooted to some degree in NASA's history" and the culture of its manned spaceflight programme. Historical organisational issues, including politics and budgets, compromises and changing priorities featured in the lifetime of the Shuttle programme.

These factors included the "engineering and design comprises made by NASA to gain approval for the Shuttle" in 1972.

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Subsequent years of resource constraint, fluctuating priorities, schedule pressures, "mischaracterisation of the Shuttle as operational

A copy of the CAIB report and (left) the launch of Columbia on 16 January 2003. NASA

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rather than a developmental" vehicle also contributed to the failure.

The CAIB points out that the NASA budget has been restricted, while at the same time it has tried to maintain the Shuttle, International Space Station (ISS) and other programmes. There were "organisational practices detrimental to safety", including a reliance on past success as a substitute for sound engineering practices.

No testing was performed to understand why some systems were not operating as planned. NASA has an unfounded "self confident outlook of it having a unique knowledge about how to safely launch people into space".

NASA had come to accept foam impacts during launch as non-critical, basically because nothing untoward happened, rather than addressing the problem.

Organisational barriers prevented effective communication of critical safety information and stifled professional differences in opinion. There was a lack of integrated management across the programme and the evolution of an informal chain of command and "decision making processes that operated outside the organisation's rules".

Concerns by many NASA workers about the foam impact on the wing were ignored or not expressed because of the culture that had developed in the agnecy.

The CAIB does not address how NASA should be reorganised but acknowledges the space agency's moves so far to mend its ways. There will be a robust and independent programme technical authority that has complete control over specifications and requirements and waivers; an independent safety assurance organisation with line authority over all levels of safety; and an organisational culture that reflects the best characteristics "of a learning organisation".

The CAIB regards improvements in this area as necessary but not all need to be operational before a return to flight.

It also says that although the Shuttle is not inherently unsafe, "if persistent, systemic flaws are not resolved, the scene is set for another accident". The physical cause of the STS-107 accident was confirmed as the breach of the lower half of the reinforced carbon-carbon panel No 8 on the leading edge of the orbiter's left wing caused by the impact of a piece of insulating foam which separated from the left bipod ramp section of the external tank at T+81.7 s into the launch.

Superheated air penetrated the breach during re-entry, progressively melting the aluminium structure of the wing, weakening it until increasing aerodynamic forces caused loss of control, failure of the wing and breakup of the orbiter.

The CAIB says that NASA could have launched a rescue bid had the agency realised how badly damaged the orbiter was, as suspected by several engineers whose voices were not heard or were muted by reluctance to speak out. The Space Shuttle Atlantis could have been launched to bring the Columbia crew home if it was impossible to repair the suspected damage to the wing.

The Columbia crew died as a result of the thermal degradation of the stuctrural properties of the orbiter, which resulted in a rapid catastrophic seqential stuctural breakdown, rather than an instantaneous explosive failure.

Separation of the crew module/forward fuselage assembly from the front of the payload bay was followed by a breakup as a result of ballistic heating and dynamic loading. This occurred between 140,000 ft and 105,000 ft over a period of 24 s at speeds of 13,000 mph. About 40 percent to 50 percent by weight of the crew module was recovered.

The acceleration levels before the break-up were not lethal and the death of the seven crew was due to blunt trauma and hypoxia. The exact time of death sometime after 09.00.19 EST cannot be determined.

It is pointed out that from the recovered video of the crew during the early stages of re-entry over the Pacific, the procedure for the use of helmets and gloves "was not strictly followed". Three crew members were not wearing gloves and one was not wearing a helmet. This did not affect their chances of survial, however.

The CAIB makes 15 "return to flight" recommendations including that the loss of foam from the ET be prevented, that there be improved imaging of the Shuttle stack from lift-off through to ET separation and on-orbit inspection, and if necessary, repair of the thermal protection system if possible.

The CAIB recommendations

Thermal Protection System

These recommendations are not listed in priority order (RTF = Before Return To Flight).

Initiate an aggressive programme to eliminate all External Tank Thermal Protection System debris-shedding at the source with particular emphasis on the region where the bipod struts attach to the External Tank. [RTF]

Initiate a programme designed to increase the Orbiter's ability to sustain minor debris damage by measures such as improved impact-resistant Reinforced Carbon-Carbon and acreage tiles. This programme should determine the actual impact resistance of current materials and the effect of likely debris strikes. [RTF]

Develop and implement a comprehensive inspection plan to determine the structural integrity of all Reinforced Carbon-Carbon system components. This inspection plan should take advantage of advanced non-destructive inspection technology. [RTF]

For missions to the ISS, develop a practicable capability to inspect and effect emergency repairs to the widest possible range of damage to the Thermal Protection System, including both tile and Reinforced Carbon-Carbon, taking advantage of the additional capabilities available when near to or docked at the Space Station.

For non-Station missions, develop a comprehensive autonomous (independent of Station) inspection and repair capability to cover the widest possible range of damage scenarios.

Accomplish an on-orbit Thermal Protection System inspection, using appropriate assets and capabilities, early in all missions.

The ultimate objective should be a fully autonomous capability for all missions to address the possibility that an ISS mission fails to achieve the correct orbit, fails to dock successfully, or is damaged during or after undocking. [RTF]

To the extent possible, increase the Orbiter's ability to successfully re-enter Earth's atmosphere with minor leading edge structural sub-system damage.

In order to understand the true material characteristics of Reinforced Carbon-Carbon components, develop a comprehensive database of flown Reinforced Carbon-Carbon material characteristics by destructive testing and evaluation.

Improve the maintenance of launch pad structures to minimise the leaching of zinc primer onto Reinforced Carbon-Carbon components.

Obtain sufficient spare Reinforced Carbon-Carbon panel assemblies and associated support components to ensure that decisions on Reinforced Carbon-Carbon maintenance are made on the basis of component specifications, free of external pressures relating to schedules, costs, or other considerations.

Develop, validate, and maintain physics-based computer models to evaluate Thermal Protection System damage from debris impacts. These tools should provide realistic and timely estimates of any impact damage from possible debris from any source that may ultimately impact the Orbiter. Establish impact damage thresholds that trigger responsive corrective action, such as on-orbit inspection and repair, when indicated.

Imaging

Upgrade the imaging system to be capable of providing a minimum of three useful views of the Space Shuttle from liftoff to at least Solid Rocket

Chairman of the Columbia Accident Investigation Board, retired US Navy Admiral Harold Gehman (right), presents the results of the panel's investigation to NASA Administrator Sean O'Keefe. NASA

Booster separation, along any expected ascent azimuth. The operational status of these assets should be included in the Launch Commit Criteria for future launches. Consider using ships or aircraft to provide additional views of the Shuttle during ascent. [RTF]

Provide a capability to obtain and downlink high-resolution images of the External Tank after it separates. [RTF]

Provide a capability to obtain and downlink high-resolution images of the underside of the Orbiter wing leading edge and forward section of both wings' Thermal Protection System. [RTF]

Modify the Memorandum of Agreement with the National Imagery and Mapping Agency to make the imaging of each Shuttle flight while on orbit a standard requirement. [RTF]

Orbiter Sensor Data

The Modular Auxiliary Data System instrumentation and sensor suite on each Orbiter should be maintained and updated to include current sensor and data acquisition technologies.

The Modular Auxiliary Data System should be redesigned to include engineering performance and vehicle health information, and have the ability to be reconfigured during flight in order to allow certain data to be recorded, telemetered, or both as needs change.

Wiring

As part of the Shuttle Service Life Extension Program and potential 40-year service life, develop a state-of-the-art means to inspect all Orbiter wiring, including that which is inaccessible.

Bolt Catchers

Test and qualify the flight hardware bolt catchers. [RTF]

Closeouts

Require that at least two employees attend all final closeouts and intertank area hand-spraying procedures. [RTF]

Micrometeoroid and Orbital Debris

Require the Space Shuttle to be operated with the same degree of safety for micrometeoroid and orbital debris as the degree of safety calculated for the ISS. Change the micrometeoroid and orbital debris safety criteria from guidelines to requirements.

Foreign Object Debris

Kennedy Space Center Quality Assurance and United Space Alliance must return to the straightforward, industry-standard definition of "Foreign Object Debris" and eliminate any alternate or statistically deceptive definitions like "processing debris." [RTF]

Why the accident occurred

Scheduling

Adopt and maintain a Shuttle flight schedule that is consistent with available resources. Although schedule deadlines are an important management tool, those deadlines must be regularly evaluated to ensure that any additional risk incurred to meet the schedule is recognised, understood, and acceptable. [RTF]

Training

Implement an expanded training programme in which the Mission Management Team faces potential crew and vehicle safety contingencies beyond launch and ascent. These contingencies should involve potential loss of Shuttle or crew, contain numerous uncertainties and unknowns, and require the Mission Management Team to assemble and interact with support organisations across NASA/Contractor lines and in various locations. [RTF]

Organisation

Establish an independent Technical Engineering Authority that is responsible for technical requirements and all waivers to them, and will build a disciplined, systematic approach to identifying, analysing, and controlling hazards throughout the life cycle of the Shuttle System. The independent technical authority does the following as a minimum:

- Develop and maintain technical standards for all Space Shuttle Program projects and elements
- Be the sole waiver-granting authority for all technical standards
- Conduct trend and risk analysis at the sub-system, system, and enterprise levels
- Own the failure mode, effects analysis and hazard reporting systems
- Conduct integrated hazard analysis
- Decide what is and is not an anomalous event
- Independently verify launch readiness
- Approve the provisions of the recertification programme

The Technical Engineering Authority should be funded directly from NASA Headquarters, and should have no connection to or responsibility for schedule or programme cost.

NASA Headquarters Office of Safety and Mission Assurance should have direct line authority over the entire Space Shuttle Program safety organisation and should be independently resourced.

Reorganise the Space Shuttle Integration Office to make it capable of integrating all elements of the Space Shuttle Program, including the Orbiter.

A look ahead

Organisation

Prepare a detailed plan for defining, establishing, transitioning, and implementing an independent Technical Engineering Authority, independent safety programme, and a reorganised Space Shuttle Integration Office. In addition, NASA

Early concerns over possible damage

It has been revealed that Bryan O'Connor, a former Space Shuttle commander, now chief of safety at NASA received an email during the STS-107 Columbia mission from a NASA Johnson Space Centre engineer with a copy of an email sent to him by another engineer regarding potential damage to the landing gear door of the left wing of Columbia after the foam debris hit during launch. O'Connor's response was indicative of the NASA-wide assumption that there was no danger.

Former astronaut and Kennedy Space Centre director, Roy Bridges, who was moved to Langley Research Centre in the wake of the Columbia accident, has started work on the formation of the NASA Engineering and Safety Centre. The independent saftey unit, based at Langley, will perform engineering assessment and testing support for NASA missions and serve as a clearing house for staff concerns during future missions.

Jerry Smelser, the Space Shuttle External Tank manager at NASA's Marshall Space Flight Centre has become the first casualty of the Columbia Accident Investigation Board's report into the loss of STS-107. The report says that Smelser, who has been reassigned to a post of advisor, used erroneous information to argue in favour of a previous Shuttle launch.

NASA administrator Sean O'Keefe says he is accountable for the Columbia accident but notes that NASA's budget was cut by 40 percent over the last 10 years and that the agency has lacked a mission of national priority since Apollo and the nation and NASA has lost motivation. Despite the cuts, NASA plunged into the costly International Space Station whose construction depended on the Space Shuttle, said O-Keefe.

The effects of the Columbia accident on the US Spacehab company is illustrated by its $20.1 million loss in the fourth quarter ended 30 June. The company says it has sufficient funds to continue operations and new initiatives for at least the next fiscal year.

The 248-page Columbia Accident Investigation Board's report was originally over 1,000 pages long and some of the missing material may be issued separately by some individual members of the CAIB, including US Air Force Brigadier Duane Deal. He is concerned that NASA will not make all the required safety changes before a return to flight and says that even tougher recommendations were buried, downplayed or dropped from the final condensed report. Of special concern is that the 10th chapter of the CAIB report entitled "Other Significant Observations" will be ignored. These include concerns about corroded parts, brittle bolts, launch pad systems - and weakened full-circumference rings attaching the fuel tank to the solid rocket boosters.

This final observation is potentially very serious and interesting in that the original half-circumference rings on the system up to and including the STS 51L Challenger accident contributed to the loss of this orbiter. The lurching "twang" at SSME ignition placed far more stress on the lower part of the SRBs than anticipated, not only affecting the O rings (with cold weather, which was blamed officially for the accident) but also the entire lower attachment structure. This resulted in full-circumference attach rings being introduced very quietly after Challenger. This design oversight issue has been classified by the US Government and is unlikely ever to be admitted officially.

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should submit annual reports to Congress, as part of the budget review process, on its implementation activities. [RTF]

Recertification

Prior to operating the Shuttle beyond 2010, develop and conduct a vehicle recertification at the material, component, subsystem, and system levels. Recertification requirements should be included in the Service Life Extension Program.

Closeout photos/drawing system

Develop an interim programme of closeout photographs for all critical sub-systems that differ from engineering drawings. Digitise the closeout photograph system so that images are immediately available for on-orbit troubleshooting. [RTF]

Provide adequate resources for a long-term program to upgrade the Shuttle engineering drawing system including:

- Reviewing drawings for accuracy
- Converting all drawings to a computer-aided drafting system
- Incorporating engineering changes.

81242

Spaceshots

- Indonesia is planning to develop a clim monitoring satellite to assist the county agricultural industry. The satellite will b built by Germany's University of Berlin a launched by India.
- Globalstar, which is expected to be take out of Chapter 11 bankcrupcy as a resul the acquisition of a majority interest by is to alter its new constellation network five satellites in each of eight orbital planes. The new 40-satellite network is result of in-orbit failures of several the original 48 spacecraft, six in each plane creating service gaps.
- Rosaviakosmos is resuming discussions Iran about developing and launching a communications satellite for the country The 850kg comsat would be launched b Soyuz booster.
- Data based on science observations ma by NASA's Mars Global Surveyor Therma Emission Spectrometer indicate that the Planet has always been cold, frozen, icy barren and not at one time covered in oceans and enjoying an temperate clim as thought earlier, says Arizona State University geologist Philip Christensen. wont' stop the "Mars life" hype howeve
- Russia's military services will launch German satellites built by OHB-System f Plesetsk in 2005-07, which may come a surprise to European Arianespace affilia company Starsem, which offers the Soy The five German SAR-Lupe satellites wi used for national radar reconnaisance.
- Russia's Omsk-based Polyot space comp has developed a new 160 kg version of Nadezhda search and rescue satellite fc Cospas Sarsat system.
- The Orbital Recovery Corporation has thrown its hat into the ring, proposing Spacecraft Life Extension System space to extend the lifetime of the Hubble Sp. Telescope by boosting its orbit or movi the craft into an orbit that could enable rendezvous with the International Spac Station for in-orbit servicing.
- The communications satellite downturn i 2002, in which just three new satellites v ordered, seems to be over. Ten new craft been ordered so far this year and it is predicted that 20 will be ordered in 2005 2006, mainly to replace older satellites ir space, it was reported from World Satelli Business Week" conference in Washington

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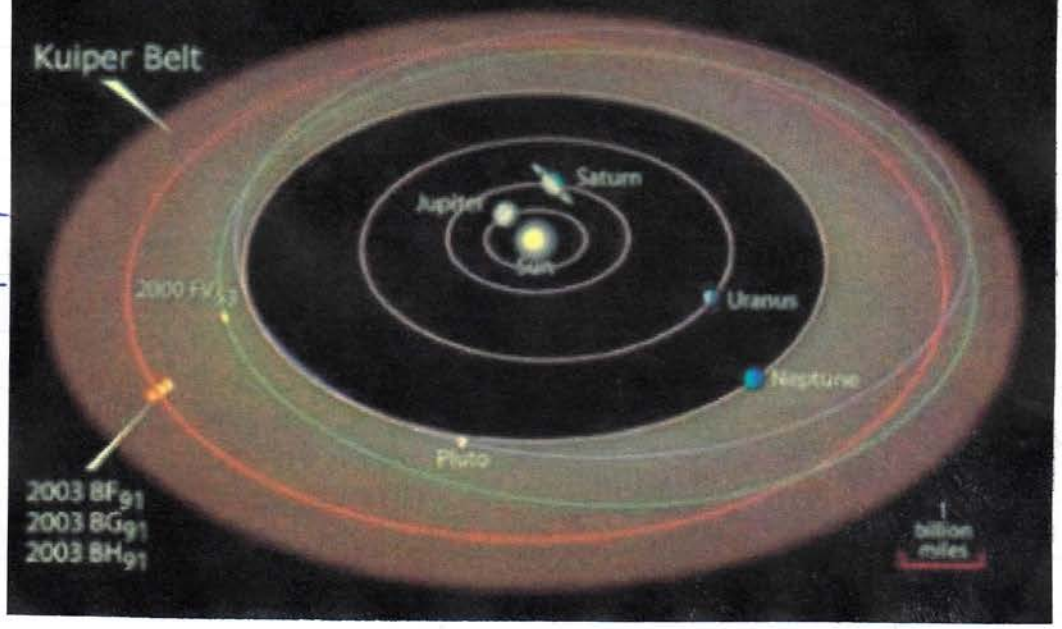
Three Kuiper Belt Objects discovered

Using Hubble Space Telescope's Advanced Camera for Surveys (ACS), scientists have discovered three of the faintest, smallest objects ever detected beyond Neptune. This diagram compares the orbits of the three new Kuiper Belt members — 2003 BF91, 2003 BG91, and 2003 BH91 — with those of the giant planets Jupiter, Saturn, and Neptune. The orbits are drawn to scale. The three new discoveries share similar orbits. Also shown are the orbits of two other Kuiper Belt members: the well-known Pluto and previously discovered 2000 FV53. The planets are not drawn to scale. The circle that is labeled "Sun" is in fact large enough to represent the entire orbit of Earth.



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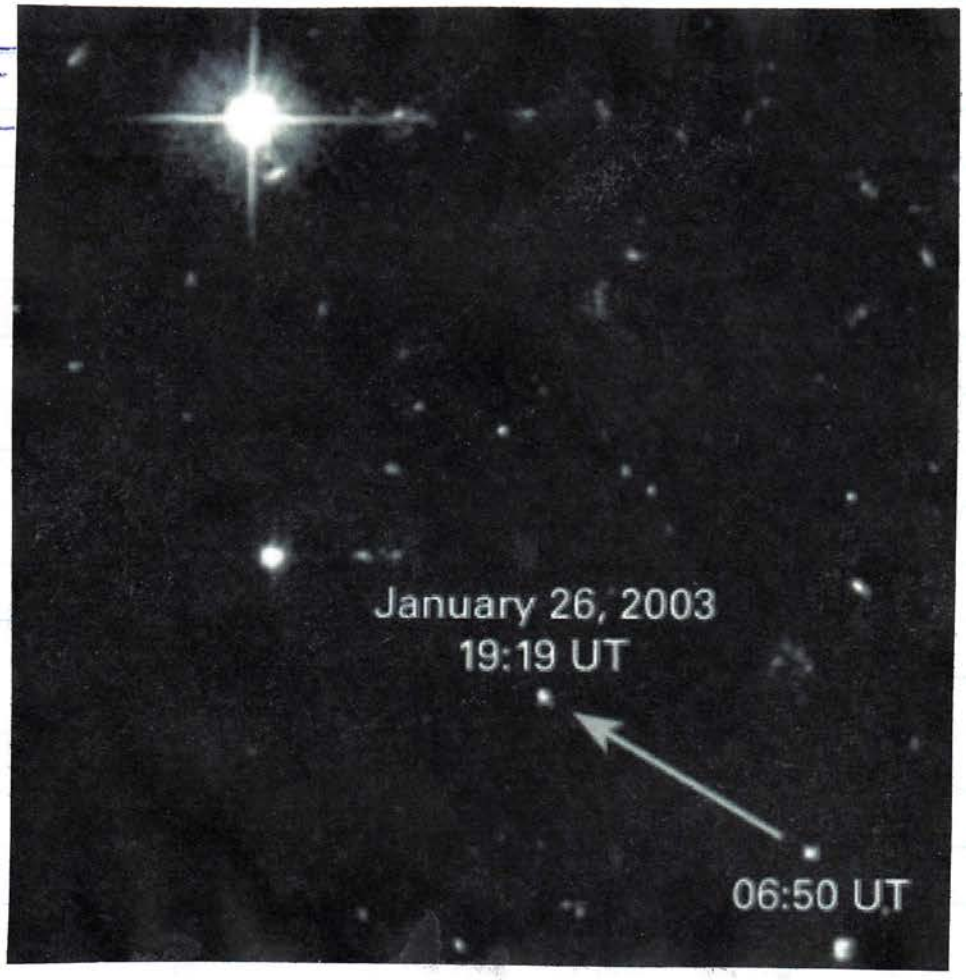

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ISAS Joins Bepi Colombo

TOKYO

Japan's cabinet-level Space Activities Commission has approved plans for the Institute of Space and Astronautical Science to make the 2010 Bepi Colombo Mercury mission series its third big planetary program over the next decade.

The first budget request is for fiscal 2004; the total is expected to reach 13.5 billion yen ($112 million).

Details of the level of Japanese participation were not present, but in the past Japan has talked about supplying the secondary vehicle to explore Mercury's magnetotail. Bepi Colombo is expected to be one of the first to use ESA's new standard common bus design called Devils (*AW&ST* Sept. 23, 2002, p. 36).

The current program calls for ESA to develop and assemble a three-vehicle flotilla to the inner-most planet, including the Mercury Surface Element (MSE), Mercury Planetary Orbiter (MPO) and Mercury Magnetospheric Orbiter (MMO). Launch will be by two Russian Soyuz boosters no earlier than late 2010, which would put them at Mercury in the summer of 2014. The survey will continue for about a year.

81246

AVIATION WEEK & SPACE TECHNOLOGY/JULY 7, 2003

81247

Onderwijzers de ruimte in

Er zijn heel wat scholieren, die hun onderwijzers of leraren de ruimte in zouden wensen. Terecht of onterecht. Een wens die toch niet uit kon komen. Maar pas op!

NASA heeft namelijk een oproep gedaan aan leerkrachten te solliciteren voor een baan als 'opvoedkundig astronaut'. In Amerika bleek voor die baan heel veel belangstelling te bestaan. Liefst ruim 1600 leerkrachten reageerden (of was het om eindelijk van de leerlingen af te zijn?). Allemaal zullen ze aan een selectieprocedure onderworpen worden. Zullen hun onderwijskundige talenten (?) net zo vaardig zijn als met het omgaan van bijvoorbeeld een robotarm en het uitvoeren van opdrachten in gewichtloze toestand in de ruimte? En in plaats van het geven van opdrachten aan scholieren, mogen zij nu opdrachten van hen uitvoeren.

Diegene die uiteindelijk wordt uitverkoren, mag zeker twee keer een ruimtevlucht maken. Een contract heeft NASA al met de Russische ruimtevaartorganisatie getekend. Immers zij zullen hun vlucht maken aan boord van de Sojoez TMA. De eerste vlucht staat gepland voor begin 2005. Net als bij iedere taxivlucht moet nu ook zo'n 20 miljoen dollar op tafel komen. Maar dat behoeft door de leerkracht zelf niet betaald te worden. Dat is voor rekening van NASA.

EUROPE-TO-MARS **Europe's Mars Express, the ambitious orbiter/lander combination, is now scheduled to lift off for the Red Planet on June 2, after a faulty power distribution unit was removed and repaired. The mission's Soyuz vehicle will launch a little before midnight local time from Baikonur Cosmodrome. The mission will kick off a major new U.S. and European assault on Mars. If all the flights are successful, there will be a new orbiter flying above Mars and three new landers, two of them U.S. rovers, operating simultaneously on the surface by early 2004. The first of the U.S. Mars Exploration Rovers is set for launch from Cape Canaveral on June 5 on a Delta II, while the second U.S. rover is set for launch on a Delta II with larger solid rocket motors on June 25. The first rover, using the Delta II's standard solids, must launch by June 19, while the launch window for the second extends to July 15. Both U.S. rovers are identical, but trajectory differences between the two missions dictate the use of different solid rocket booster configurations.**

81248

Soyuz TMA-1 crew visit to the Netherlands on 7 July 2003

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With optimum results.
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Rollout and launch (right) of the Saturn V rocket on 3 March 1969. Lift-off of the 10-day mission was from Kennedy Space Center, Florida.

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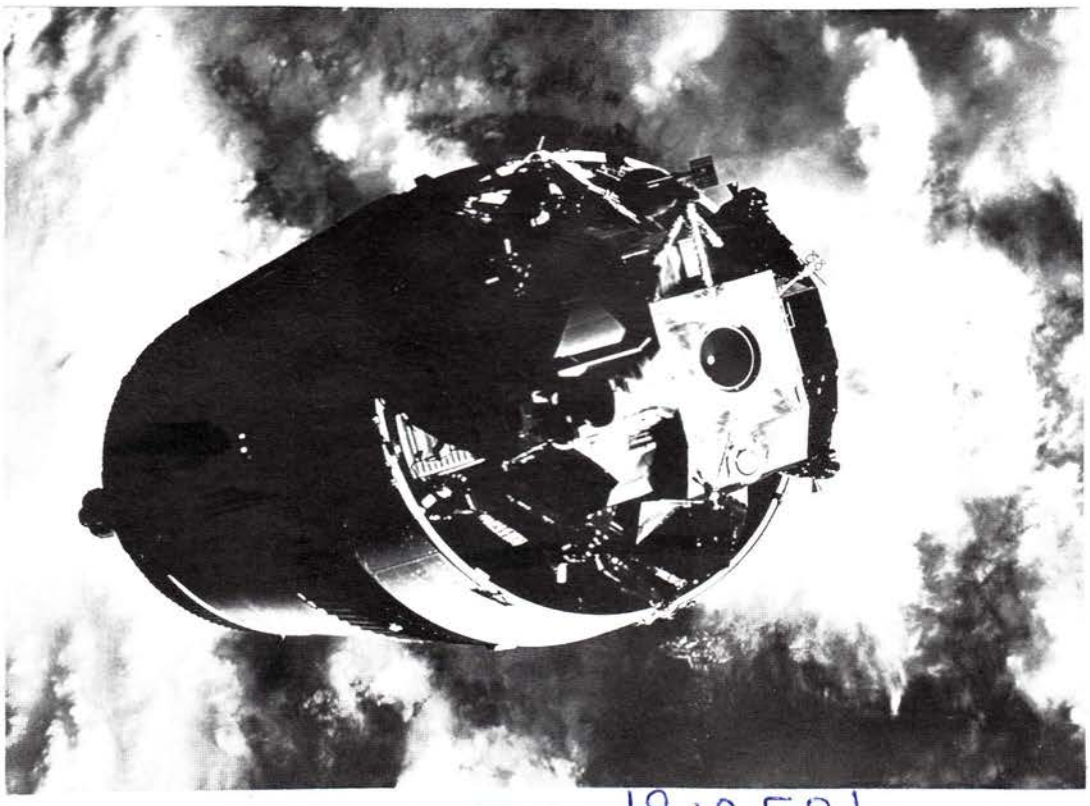

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Vertrek van de bemanning van de Apollo 8 naar de lanceerplaats, als zij op 21 december 1968 hun historische vlucht beginnen. Van links naar rechts: William Anders, James Lovell en commandant Frank Borman.

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Verzwakt door acht maanden gewichtloosheid aan boord van de *Saljoet 7*, rusten drie kosmonauten naast het ruimtevaartuig dat hen terug heeft gebracht naar de aarde uit in speciale stoelen. Hun verblijf in het ruimtestation, in 1984, toonde aan dat interplanetaire reizigers na het bereiken van hun bestemming dagenlang niet in staat tot werken zouden kunnen zijn.

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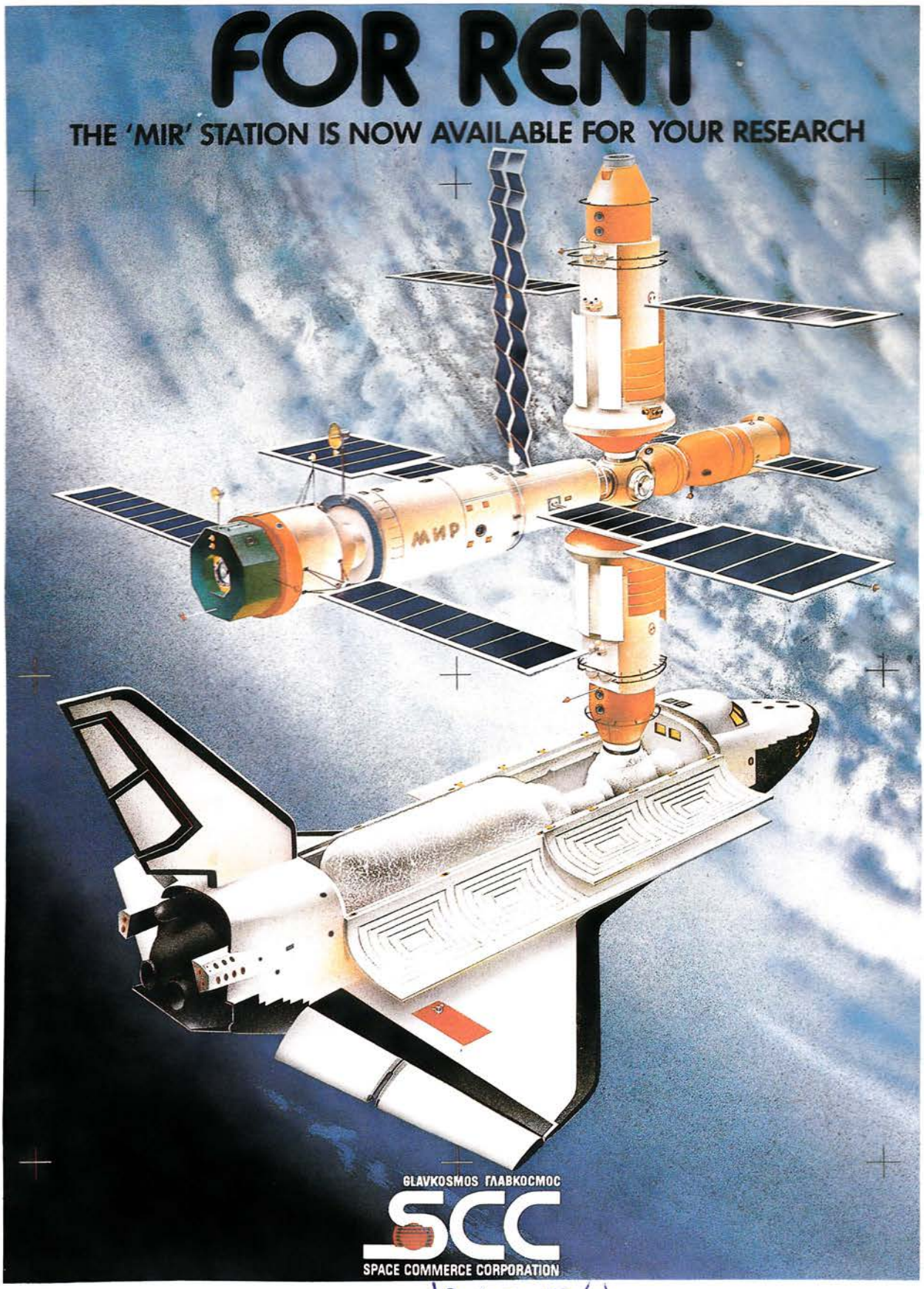
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First Space Shuttle set for 'retirement'

by Jacques van Oene

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The first Space Shuttle has had a truly remarkable 28-year history. From its birth in August 1975 until this April when parts of it were used to assist the Columbia inquiry, Enterprise has had a long and varied career. Now, as the orbiter is prepared for permanent display at the Smithsonian Air and Space Museum in Northern Virginia, Spaceflight author Jacques van Oene recalls the unique story of the Shuttle that never flew in space.

When NASA decided at the end of the Apollo Moon programme that it needed something new for future space travel, various concepts were proposed - and from those emerged the Space Shuttle. North American Rockwell was given the prime contract in July 1972 to build five Space Shuttle orbiters, the first one being a prototype to be used for glide and ground tests. The other four would fly in space. In 1987 Rockwell was awarded a contract to build, from spare parts a sixth orbiter, the replacement for Challenger.

Work to built the first Space Shuttle started in 1974 at Rockwell's Air Force Plant 42 in Palmdale, California. Final assembly of all the components that came from the various sub-contractors started in March 1975. On 25 August 1975, the final assembly was complete. In the mean time NASA had chosen a name for its first Shuttle, also know as Orbiter Vehicle 101 (OV-101). It would carry the name 'Constitution' in honour of the US Constitution's Bicentennial. But fans of the popular TV science fiction series Star Trek had other ideas about the name of the first reusable manned spacecraft. They organised a mail campaign to the White House (President Gerald Ford) to re-name OV-101 and when the doors at Plant 42 opened on 17 September 1976, the name on the side of the orbiter was 'Enterprise'. The "Trekkies" had only forgotten one thing - Enterprise was not built to fly in space. The plan at the time was to refit OV-101 for space flight after the glide tests were over in 1977. However NASA chose to make Structural Test Article 099 space-worthy, (it became OV-099, Challenger) which was much cheaper than making the necessary changes to Enterprise. So a real 'starship' Enterprise would never fly in space.

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Roll out of the first Space Shuttle orbiter (OV-101) Enterprise at Air Force Plant 42, Palmdale, California (note the Apollo capsule near the wing of Enterprise) on 18 September 1976 and (above) Runway Taxi Tests at NASA's Dryden Flight Research Center on 15 February 1977.

81259

Approach and landing tests

On 31 January 1977 Enterprise was transported 48 miles over land from Palmdale to the nearby Dryden Flight Test Center located at Edwards Air Force Base, to begin a series of flight tests; the so-called Approach and Landing Tests (ALT). The first was to test the Shuttle Carrier Aircraft (SCA), a Boeing 747 that NASA bought from American Airlines and was modified by Boeing to support the Space Shuttle. Later it would serve as the Shuttle's ferry craft to bring it back to Kennedy Space Center after each mission. In February 1977, the first flight tests started with a taxi test on the runway, followed by five captive inactive flights in which Enterprise stayed attached to the SCA. In June the SCA and Enterprise took to the sky again for three captive active flights. This time there was a crew aboard the Shuttle. NASA had chosen four astronauts, divided in to two crews: Fred Haise and Gordon Fullerton (Crew-1) and Joe Engle and Richard Truly (Crew-2). During

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Emblem to commemorate the cross country flight of Enterprise in 1978 from the Dryden Flight Research Center to the Johnson Space Center and then on to the Marshall Space Flight Center.

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This circular patch was for the ground crews of the 1977 Approach and Landing tests programme.

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Enterprise and its Boeing 747 Shuttle Carrier Aircraft are pictured flying near the Eiffel Tower. An emblem designed for the 1983 Paris Air Show.

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The official insignia for the Space Shuttle Approach and Landing Test (ALT) flights.

the three test flights the astronauts had a chance to power up Enterprise and test the flight controls while it was in the sky attached to the SCA.

In five free flights, beginning in August 1977, the Shuttle was released from the SCA at an altitude ranging from 19,000 to 26,000 feet. The first three free flights were flown with a tail cone covering the (simulated) engines of the orbiter and it took about five minutes from separation to landing, a good preview of how the Space Shuttle would return from space. Enterprise used no engines or propulsion system as it glided in to land.

Astronaut Gordon Fullerton said after the first flight: "After Fred hit the separation button, seven explosive bolts released us with a loud kabang, and, as predicted, we went straight up…Before we cleared the tail of the 747 one of our four general purpose computers had failed. I saw a big X on one of the displays in front of me, so I was not getting any current information. The procedure for a GPC fail was to pull some circuit breakers and turn off some switches. I referred to a cue card and got very busy…Then I realised, kind of a shock, Hey wait a minute! We are flying great…I missed the whole first part of the flight."

On the second and third free flights the tail cone was removed, which increased drag from the exposed engines, giving the astronauts less time to carry out tests. The fourth flight lasted only two minutes and 34 seconds. The fifth and final free flight was not as smooth as the previous ones. At the end of the two minute flight, with Enterprise landing on the Edwards Air Force Base concrete runway, a serious problem with the Space Shuttle flight control system, also known as Pilot Induced Oscillation (PIO), was discovered. Enterprise bounced several times and veered across the runway with the crew almost losing control of the orbiter.

Further research using other NASA aircraft, especially the F-8 Digital-Fly-By-Wire aircraft, led to correction of the PIO problem before the first orbital flight. Manned test flights with OV-101 were now completed but in November 1977 four more ferry test flights were performed with the SCA and Enterprise.

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Ground tests

After the ALT programme the orbiter was made ready for Vertical Ground Vibration Tests at NASA's Marshall Space Flight Center in Alabama. Enterprise flew to Marshall in March 1978 and was transported by truck to the test stand for more than a year of tests. The test stand at Marshall was originally built for the Saturn V rocket but was partially rebuilt for these tests. It was in this test stand that a Space Shuttle was mated with an External Tank (ET) and Solid Rocket Boosters (SRB) for the first time.

Enterprise mated to SRB's and External Tank for a Flight Vehicle Verification test at SLC-6 new Space Shuttle launch complex at Vandenberg Air Force Base on 19 February 1985.

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Enterprise was used to simulate three aspects of ascent: lift off, in flight moments before SRB separation, and high altitude prior to orbital insertion. These tests were completed in March 1979 and once mated again with the SCA, Enterprise was flown to Kennedy Space Center on April 10 for fit and function checks. At KSC, Enterprise was mated with dummy SRB's and an External Tank that was scheduled to fly with STS-1. The first roll-out of a Space Shuttle to the launch pad took place on 1 May 1979.

Enterprise needed almost eleven hours to roll from the VAB to Pad-39A. At the launch pad the complete Shuttle stack was used to verify that all that was built was in the right place to support a real launch. During the three months that Enterprise stayed at the launch pad, a variety of escape procedures were also tested. That summer at the end of July the complete stack returned to the VAB and was de-mated. Enterprise left KSC in August for a moral boost visit to Vandenberg AFB in California to give workers, who were re-building SLC-6 for Space Shuttle launches, a look at an orbiter. After that OV-101 returned to Palmdale where some parts were removed that could be used on future orbiters.

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Public relations tours

On 6 September 1981, Enterprise returned from Palmdale over land to Edwards AFB for storage, then on 4 July 1982, the day that Space Shuttle Columbia returned from her fourth space flight, Enterprise was put on display in front of its hangar to give the public a look at the first Space

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Shuttle as well. US President Ronald Reagan gave a speech in front of Enterprise with the STS-4 crew joining him. Later in the day Space Shuttle Challenger flew over, on top of the SCA, on route to KSC in preparation for its first flight.

In May 1983 Enterprise departed Edwards AFB for the first leg of a promotional tour to Canada, Europe and the Paris Air Show. For this tour, Enterprise and the SCA were given a new paint job. With the new colours, OV-101 looked more like the other orbiters. For the SCA it meant that the old American Airlines markings that were still visible on its side were finally gone.

Piloting the SCA on the Paris Air Show trip were Joe Algranti, JSC Chief Pilot, astronaut Dick Scobee and NASA Dryden Chief Pilot, Tom McMurtry. For the flight over the Atlantic Ocean several modifications to the SCA were made to protect it against possible terrorist attacks and after several overnight refuelling stops Enterprise arrived in England on 20 May. From there it flew to Germany and on 25 May the Shuttle/SCA combination arrived at Le Bourget Airport near Paris for the 11 day Air Show. During the show it made several fly-overs and visited Rome, Italy.

After the combination left Paris on 5 June it flew along the coast of Belgium and the Netherlands to England for a three day PR visit at Stanstead airport.

Enterprise arrived back at Edwards AFB on 13 June were it again was placed in storage. In March 1984 the SCA with Enterprise left Edwards for a flight to Brookley Field in Mobile, Alabama, where the orbiter was lifted off the SCA and placed on a large barge that would bring it over the Mississippi river to New Orleans for the 1984 World Fair. Enterprise stayed in New Orleans until November when it was flown to Vandenberg AFB for its next task.

In January 1985 Enterprise was towed overland to SLC-6 for Flight Vehicle Verification tests of the new Space Shuttle launch site. These tests were similar to those at KSC in 1979. The tests at SLC-6 lasted until May 1985. Enterprise was flown from Vandenberg to Edwards for storage until September 1985, when it was flown to KSC where it was parked next to the Saturn-V rocket at KSC for several months. On 18 November, NASA handed Enterprise officially over to the Smithsonian National Air and Space Museum (NASM) and OV-101 was flown to Dulles International Airport near Washington DC. At Dulles Enterprise was put on display alongside one of the runways for several years.

Enterprise final tasks

In June 1987 NASA again used Enterprise. This time the tests were done on one of the runways of the Dulles Airport. In the wake of the Challenger accident, engineers wanted to know if an orbiter could use a landing barrier. These barriers are used on ships by the military to catch damaged aircraft. The test of the Shuttle Orbiter Arresting System (SOAS) was successfully completed and the SOAS was placed at the three Trans-oceanic Abort Landing (TAL)-sites.

To this day NASA still visits Enterprise to use parts of the orbiter for a variety of tests. In 1997 it borrowed the nose landing gear and in 1999 samples of wires were taken out for tests when the other four orbiters had serious problems with their Kapton wires. The wires in Enterprise were the oldest available to NASA for tests.

In April 2003, in the wake of the Space Shuttle Columbia accident, The Columbia Accident Investigation Board (CAIB) requested that the main landing gear door of Enterprise would be needed for Thermal Protection System (TPS) tiles tests. The left main landing gear door of Enterprise was flown to KSC and in one of the Orbiter Processing Facility's workers placed the TPS tiles on the door. After that was completed the door was transferred to the Southwest Research Institute for impact testing. The CAIB also used part of Enterprise's left wing; the T-seals were used for foam impact tests in June and July 2002.

Enterprise remains in storage at a hangar at Dulles Airport until it will be moved to the James S. McDonnell Space Hangar at the new Smithsonian National Air and Space Museum companion facility, the Steven F. Udvar-Hazy Center, next to the Dulles Airport in Northern Virginia, in November 2003.

Enterprise will be visible when the centre opens on 15 December 2003 but the space hangar will not be accessible to the public because the Shuttle will need to undergo some cleaning work and other artefacts will have to be moved in. It is expected that Enterprise will be fully on display in the spring of 2004.

President Ronald Reagan in front of Enterprise at the end of Space Shuttle Columbia flight STS-4 at Edwards Air Force Base on 4 July 1982. From left, astronaut Ken mattingly, President Reagan (waving) and astronaut Henk Hartsfield.

The Space Shuttle Enterprise awaits public display in a hangar at Dulles International Airport near Washington DC. In front of Enterprise on the left side of the photo, wrapped in a plastic cover, is the European built Spacelab flight module No. 2.

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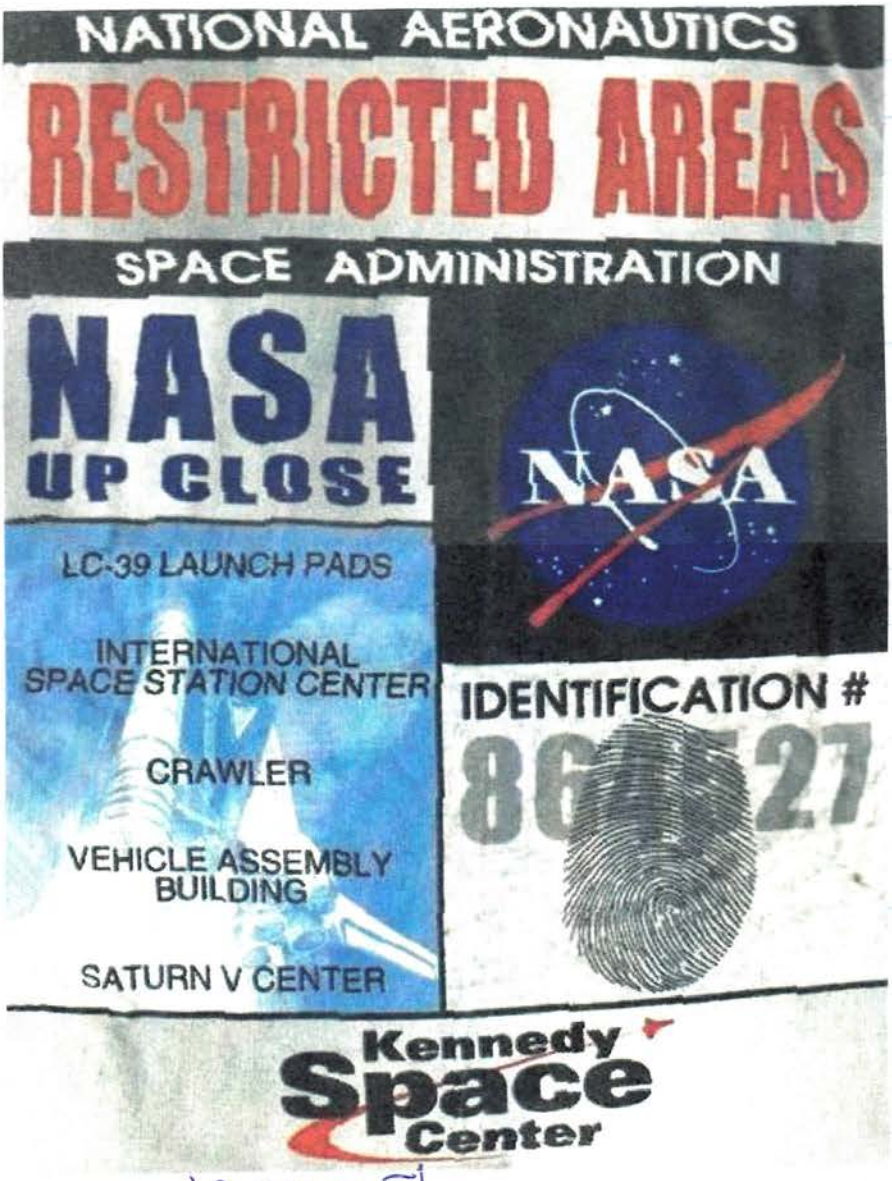

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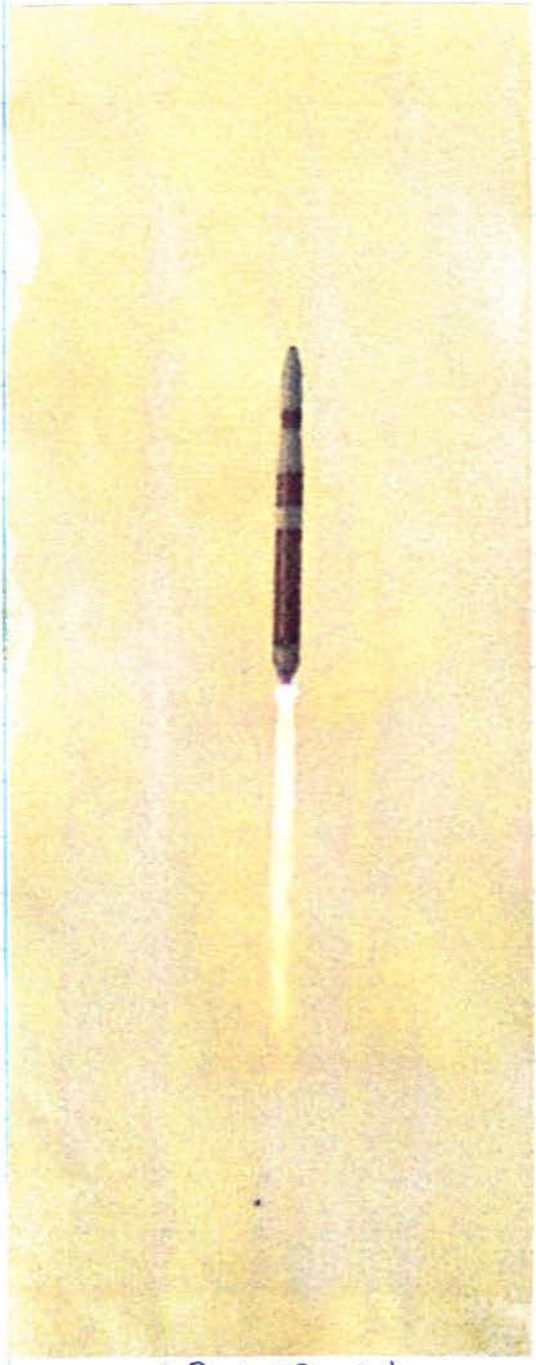

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THE RE/

The first Delta IV Heavy—a candidate to launch the OSP—has been assembled here for flight test

CRAIG COVAULT/CAPE CANAVERAL

The first U.S. Air Force/Boeing "Delta IV Heavy" Evolved Expendable Launch Vehicle, a strong candidate to be the next U.S. manned launch vehicle, has been assembled here in preparation for rollout to Launch Pad 37B for several months of checkout before a demonstration flight in May 2004.

The nearly 2-million-lb.-thrust vehicle combines three Delta IV common booster cores and three Rocketdyne liquid oxygen/hydrogen RS-68 engines.

The IV Heavy, and its enlarged upper stage, powered by an advanced version of the Pratt & Whitney RL10 oxygen/hydrogen engine, is designed to place more than 50,000 lb. in low-Earth orbit and nearly 30,000 lb. into geosynchronous-transfer orbit. Once fully stacked and loaded with propellant, the vehicle will stand 235 ft. tall and weigh more than 1.6 million lb.

As a vehicle already integrated and about to head to the pad, the Delta IV Heavy is a leading candidate to launch NASA's planned Orbital Space Plane (OSP) starting about 2008. The vehicle will supplement the shuttle on crew transfer missions to the International Space Station and expand human operations beyond Earth orbit. "We certainly believe the Delta IV Heavy has a bright future in the OSP program," said Dan Collins, Boeing's Delta IV project manager.

A NASA/industry team has yet to determine whether the OSP will be a winged or ballistic return vehicle and whether it will be reusable.

The fact that a candidate OSP launcher is actually built and ready for flight test is important given the urgent need to supplement the shuttle as highlighted by the Columbia Accident Investigation Board (CAIB).

It said in part: ". . . [B]ecause the shuttle is now an aging system *but still developmental in character* . . . it is in the nation's interest to replace the shuttle *as soon as possible* as the primary means for transporting humans to and from orbit."

The board also said the shuttle should retain unique station resupply mission capability, but "in the mid-term that replacement [for crew transfer] will be some form of . . . Orbital Space Plane. There is urgency in choosing that design."

The largest version of the Lockheed Martin Atlas V Heavy, not yet built, could also be an OSP launcher candidate in competition against the Delta IV Heavy.

Under initial Lockheed Martin concepts of the vehicle, a candidate Atlas V OSP heavy launcher capable of 50,000 lb. to low orbit could resemble the Delta IV Heavy with three common core boosters and three Russian RD-180 oxygen/kerosene engines.

In addition, the smaller Atlas V 552 version, with a single core, five solid rocket boosters and twin-engine RL10 upper stage, could boost 42,000 lb., possibly also meeting OSP needs.

The Delta IV will, importantly, have a long headstart on any OSP launch competition.

The Delta Heavy will have been flight tested on at least three missions going into any competition for the OSP. And its robust existing Pad 37B infrastructure here would, at the outset, be easier to convert to astronaut crew entry and evacuation from the vehicle than Lockheed's clean pad approach, with just a slim umbilical tower. Both companies could, however, opt to build pads specialized for OSP operations, and Lockheed Martin is working on clean pad concepts with crew-access capability.

Modifications to human-rate the Delta IV or an Atlas V Heavy EELV would in-

Cutaway of 235-ft. Delta IV Heavy shows common first-stage design characteristics.

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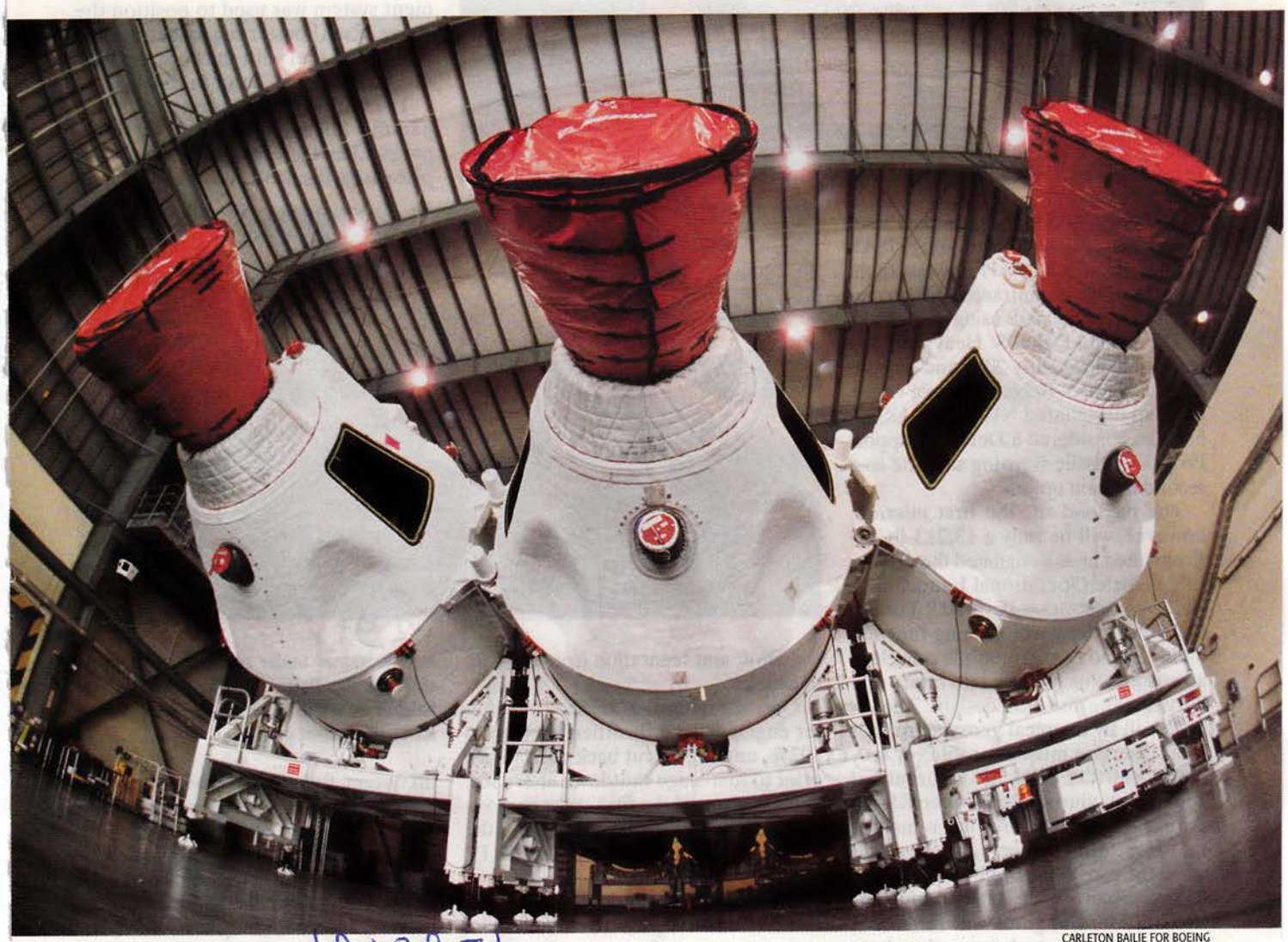
ADY HEAVY



CARLETON BAILIE FOR BOEING

This Delta IV Heavy triple RS-68 engine group, already integrated and ready for initial flight test at Cape Canaveral, could eventually propel an Orbital Space Plane.

clude the addition of health monitoring capabilities and other upgrades to the EELV hardware.

Manned operations with the Delta IV Heavy, although not likely to be a market anytime soon, could, in the long-term, help Boeing overcome its $1 billion in USAF-placed sanctions regarding the use of purloined documents from the Atlas V program (*AW&ST* July 28, p. 19).

Lockheed Martin declined to discuss its vehicle plans because of an active civil lawsuit against Boeing over the document issue.

The Air Force sanctions called for seven Defense Dept. EELV missions that had been awarded to Boeing to be given to the Atlas V. Lockheed also received three out of the four EELV second-procurement missions, bringing the companies nearly even in military launch contracts through the decade.

The missions trimmed from Boeing would not take effect until about 2006, just when any major buildup for the Orbital Space Plane would be occurring—a critical time for Boeing whichever way an OSP selection might go.

The Delta IV Heavy's payload capability is somewhat greater than the Lockheed Martin Titan IVB/Centaur. But at under $200 million, the major benefit of the Delta IV Heavy is its much greater reliability with less complex processing at only about half of Titan's cost.

The USAF requirement for a Delta IV Heavy demonstration mission came about after 2000 when the overall EELV program was restructured. Lockheed Martin at the time decided against de-

CARLETON BAILIE FOR BOEING

The three 125-ft. Common Booster Cores were linked by laser alignment in Boeing's Horizontal Integration Facility at the Cape. Upper stage will be added to center element.

A giant "KMAG" wheeled transporter capable of precise movement in all axes was used to lift each side-mounted booster into place along the core vehicle. A computer controlled laser alignment system was used to position the stages. Each booster can move about an inch in parallel with the core as slight thrust differences occur in flight.

The vehicle will be transported to the pad this fall using a horizontal transporter. Once there, it will be elevated into place using the pad's massive horizontal-lift system. Pad engineers will then complete installation and refinement of the oxygen/hydrogen fueling and defueling connections for the strap-on stages.

The vehicle will remain on the pad for 6-7 months and is scheduled for at least four cryogenic loading tests—two including full countdown rehearsals.

No other Delta IV EELV missions are scheduled between now and first launch of the Heavy, so while it will arrive horizontally, it will thunder away vertically without having to be returned to the HIF.

The potential for Delta IV Complex 37 to once again become part of the U.S. human-flight effort brings it full circle from the 1960s Apollo era. Back then, Complex 37, its Pad B now totally rebuilt for Delta IV, was used to launch Saturn 1 and 1B vehicles as part of Apollo program hardware verification, including the first space test of an unmanned Lunar Module.

veloping an Atlas V Heavy and its associated infrastructure, prompting USAF to approve a Delta IV Heavy test flight to reduce single contractor risks to future Defense payloads using the vehicle.

The second Delta IV Heavy mission is scheduled for early 2005 and is set to carry a National Reconnaissance Office payload designated NROL-26. USAF has also considered a Defense Support Program missile-warning satellite as a second mission option.

The payload for the first mission, however, will be only a 13,213-lb. instrumented mass designated the "Heavy Lift Vehicle Operational Launch Service Demonstration Payload." The 6.6 X 4.5-ft. payload will have no function other than to record multiple ride characteristics to be plugged into future military satellite and OSP designs. The vehicle will fly a typical geosynchronous orbit-insertion mission profile.

DUFFIN McGEE/INDYNE IMAGERY SERVICES FOR BOEING

Note workman under engine bells to gauge scale of the Delta IV Heavy. Rectangular hatches on white aft structure give access to RS-68 propellant pumps.

THE VEHICLE WILL liftoff on about 2-million-lb. thrust with all three RS-68s at 102% power. All three will remain at that level until 50 sec. into the flight when the core engine will throttle down to 57% power, or 425,500 lb. thrust. The two outboard engines will remain at 102% at this time, each generating about 650,000 lb. thrust at altitude.

Reducing power on the center engine will slow the rate of acceleration to reduce dynamic loads at Max-Q when the vehicle goes supersonic.

The profile will be tailored so the Heavy with its 5-meter (16.5-ft.)-dia. shroud—on later flights stretching up to 73 ft. in length—will actually experience a lower dynamic pressure than Medium versions of the Delta IV with four solid rocket motors.

At 235 sec. into the flight the two outboard engines of the Heavy will be throttled back to 57% thrust to prepare them for cutoff and separation from the core at 240 sec.

Once the outboards are shed, the center engine will be throttled back up to 102%, until again cut back to 57% just prior to first-stage shutdown at 336 sec.

Separation of the first-stage core vehicle will be followed by ignition of the RL10B-2, like that used on all Delta IV upper stages.

The first flight of Delta IV Heavy will also be the first flight of the 5-meter-dia. upper stage carrying more oxygen/hydrogen propellant than that flown on previous missions. It can also be used on two versions of the single-stack Delta IV.

Assembly of the first Delta IV Heavy in its Horizontal Integration Facility (HIF) here has been a key element of the demonstration, since it involves precisely connecting three boosters each about 135 ft. long.

The floor of the HIF was actually poured to a specification which makes it one of the most perfectly flat floor surfaces of any building in the world, specifically to enable precise alignment and mating of the Heavy's three elements.

Is This The Next Manned U.S. Launch Vehicle?

81293

ESA en Japan samen naar Mercurius

De Europese ruimtevaartorganisatie ESA en Japan bespreken momenteel het plan om gezamenlijk een ruimtevaartuig naar Mercurius te zenden. En dat belooft een hele interessante missie te worden.

Het project zal uit drie sondes bestaan, twee gaan om de planeet draaien en de derde zal een zachte landing uitvoeren. Als dat laatste lukt, zal dat een geweldige prestatie zijn. Voor het eerst zal dan het oppervlak van die planeet zeer goed bestudeed worden en zullen instrumenten ons hopelijk meer kunnen vertellen over het ontstaan van deze binnenplaneet.

De lancering van dit drietal staat gepland in 2010 met Russische Sojoezraketten. De reis zal vier jaar duren. Aangekomen bij Mercurius zullen de twee orbiters om de planeet gaan draaien en het oppervlak in kaart brengen.

81294

Japan draagt 120 miljoen euro bij en zorgt voor één orbiter. ESA neemt de andere orbiter voor haar rekening plus de lander. Daarmee is een bedrag gemoeid van ruim 520 miljoen euro.

Het wordt een hele onderneming. Overdag is het op Mercurius wel ruim 380 graden C heet, terwijl 's nachts de temperatuur daalt naar enkele honderden graden onder nul. Gezien de hitte overdag zal daarom de lander op de nachtelijke zijde van de planeet neerkomen. Langdurige testen vooraf moeten de zekerheid geven dat in die extreme kou de instrumenten goed blijven werken.

ESA had al eerder aangekondigd een ruimtevaartuig naar de planeet die het dichtst bij de zon staat, te willen sturen. Nu eventueel Japan ook aan het project wil meewerken, biedt dat meer mogelijkheden en daarvan wordt dan ook gebruik gemaakt.

81295

22389

Let's Be Friends

O'Keefe invites international role in OSP and other programs, but Europeans skeptical

FRANK MORRING, JR./BREMEN, GERMANY

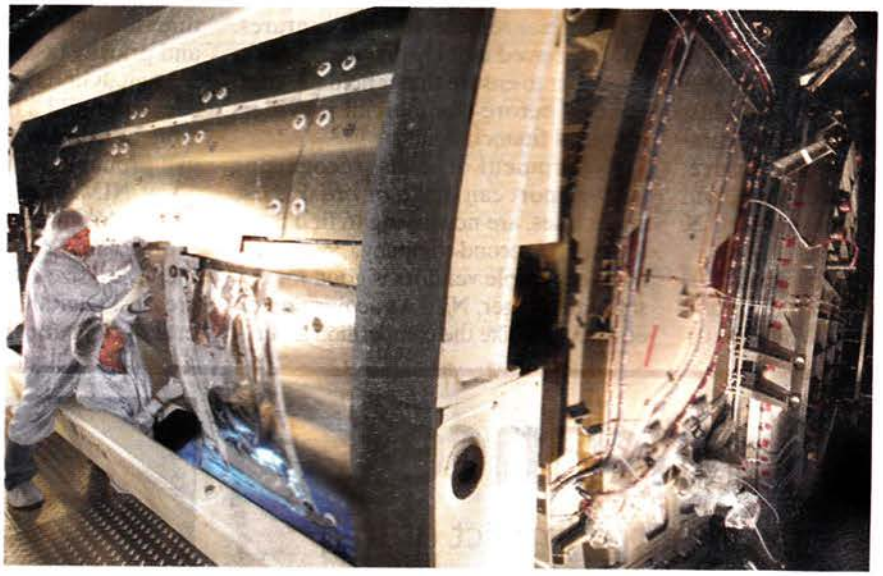
NASA Administrator Sean O'Keefe, who started his tenure at the civilian space agency with a push for closer links with the U.S. military and intelligence space programs, used an international conference here to urge more collaboration across national borders on civil space efforts, including the Orbital Space Plane.

O'Keefe praised NASA's partners on the International Space Station for pulling together in the wake of the Columbia disaster, and suggested there will be a broader international role in the new exploration policy the Bush administration is preparing as a response to the accident. Nearer term, he said there will be a role for NASA's international partners as the agency accelerates work on the OSP to relieve the strain on the surviving shuttles and Russia's Soyuz and Progress programs to support ISS.

"We would welcome that," O'Keefe said, mentioning both the immediate station-support role of OSP and its value as a stepping-stone to technology that will take human spaceflight "beyond low-Earth orbit." "So it's an opportunity to expand that beyond simply a U.S. asset."

Still, O'Keefe's remarks during a press conference at the 54th International Astronautical Federation Congress were greeted with skepticism by European space officials and industry executives who have pushed for more transatlantic joint ventures, so far without success. Stefan Graul, head of business development at EADS Space Transportation here, said U.S. companies often prefer to reinvent technology when they could strike a European partnership to gain the same capability. Graul's boss, Francois Auque, head of the EADS Space Systems Div., recently made the same complaint in Washington (*AW&ST* Sept. 22, p. 21).

Representatives of Germany's space industry briefed OSP managers from NASA and U.S. industry on European technology that could contribute to the project during a visit to Marshall Space Flight Center in Alabama last month arranged for that purpose. In addition to thermal protection system technology developed in Europe under the canceled X-38 and Hermes programs, the Germans offered technology from the Automated Transfer Vehicle (ATV) that the European Space Agency is developing for ISS logistics (*AW&ST* June 16, p. 186).



Agency heads say ISS partnership is a model for future exploration. Here, an EADS technician adjusts newly installed debris shields on ESA's Columbus module.

Graul said the ATV propulsion system would be readily adaptable to an OSP, as would the guidance, navigation and control system developed to take the ATV to an automatic rendezvous and docking with the ISS after separation from its Ariane 5 launch vehicle. The systems integration skills developed on the ATV project would also transfer nicely to an OSP, Graul said.

When OSP was moved out of the old Space Launch Initiative and put on a fast track, O'Keefe at first said the spaceplane would be a U.S. effort (*AW&ST* Nov. 18, 2002, p. 44). His position softened under pressure from Europe, and during a heads-of-agency meeting in Tokyo last year O'Keefe opened the possibility of future cooperation once the OSP requirements had been defined (*AW&ST* Dec. 23, 2002, p. 36).

O'Keefe thanked the ISS partnership, and Russia in particular, for pulling together to keep the station operating after the Columbia accident. Among the topics President Bush and President Vladimir Putin discussed in their recent Camp David summit was a possible Russian role in exploration plans beyond the ISS effort, according to O'Keefe.

As the Bush administration insider taking the lead in that planning effort, O'Keefe would say only that it is proceeding "expeditiously."

But he joined the other space agency representatives in setting up the ISS partnership as a model for future exploration, noting that critics who predicted the partnership would unravel under stress have been proved wrong by the Columbia accident. The partnership, he said, "has never been a closer cooperation than what exists today."

O'Keefe denied that his call for greater cooperation was driven by the budget constraints the Bush administration faces in the wake of the Iraq war, saying he was "under no instructions whatsoever to do that in order to defray costs." Instead, he said, "I think we're just kind of talking about it more as a means to try to encourage the maximum participation level, to the extent that it can be attained."

We don't have an exclusive corner on the market, O'Keefe said. "There are a number of very important cooperative efforts, as we've seen in the past, that really could diminish the time to achieve those objectives."

Het Andromedastelsel eet de sterren die haar begeleiden traag op

De meest nabije grote buur van ons melkwegstelsel, het Andromedastelsel, is een kannibaal. Dat werd al enige tijd vermoed, maar lijkt nu toch wel bewezen. Astronomen van de Case Western Reserve University in Cleveland, Ohio, hebben namelijk vlak bij het hoofdvlak van dit stelsel een voorheen onbekende begeleider ontdekt, waarvan de langgerekte vorm er op wijst dat hij uiteen wordt getrokken en op den duur door het moederstelsel zal worden verzwolgen. Deze ontdekking, die binnenkort wordt gepubliceerd in de *Astrophysical Journal Letters*, versterkt opnieuw de theorie dat vele en wellicht alle grote sterrenstelsels in het heelal zijn ontstaan door het geleidelijk samensmelten van een groot aantal kleinere, eerder ontstane bouwstenen.

Het Andromedastelsel (M31) staat op een afstand van 'slechts' 2,2 miljoen lichtjaar in het sterrenbeeld Andromeda en is tijdens heldere nachten al met het ongewapend oog te zien. Het heeft – evenals ons eigen melkwegstelsel – meer dan een dozijn kleinere begeleiders, die er in honderden miljoenen jaren in zeer langgerekte banen omheen draaien. Drie jaar geleden ontdekten de Britse astronoom Rodrigo Ibata en zijn collega's een lange sliert van sterren die in een baan loodrecht op het hoofdvlak van dit stelsel beweegt. Volgens hun nieuwste waarnemingen strekt deze stroom van sterren zich aan de hemel over een hoek van minstens 60 uit en zou hij het overblijfsel van een uiteengevallen begeleider van M31 kunnen zijn.

In de afgelopen jaren zijn ook rond ons eigen melkwegstelsel verscheidene sterrenstromen gevonden die 'fossielen' van uiteengevallen begeleiders zouden kunnen zijn. Als de baan van zo'n begeleider hen door het hoofdvlak van het melkwegstelsel voert, worden er door getijdenkrachten sterren uit losgetrokken die zich langs de baan gaan verspreiden. Heather Morrison en haar collega's hebben nu vlak bij het hoofdvlak van het Andromedastelsel een begeleider ontdekt die al wel sterk door getijdenwerking wordt vervormd, maar nog niet geheel uiteen is getrokken. Hij heeft aan de hemel een diameter van bijna één graad, maar is zo lichtzwak dat hij tot nu toe niet tegen de heldere achtergrond van M31 zelf was opgevallen.

De nieuwe begeleider, Andromeda VIII, bevindt zich aan de voorzijde van het Andromedastelsel en verraadt zich door zijn snelheid: die verschil ongeveer 200 kilometer per seconde van de snelheden van de sterren van het Andromedastelsel zelf. Bovendien bevinden zich in het gebied van de begeleider twee wolken waterstofgas die dezelfde snelheid hebben. De begeleider heeft een massa die typerend is voor die van de andere begeleiders van het Andromedastelsel die (nog) niet door getijdenkrachten worden vervormd. Morrison en haar collega's suggereren dat een deel van de eerder door Ibata ontdekte sterrenstroom wel eens van Andromeda VIII afkomstig zou kunnen zijn, maar dat zal pas door verder onderzoek kunnen worden uitgemaakt.

Astronomen denken dat het grootste deel van de min of meer bolvormige 'halo' van lichtzwakke materie rond het Andromedastelsel uit verorberde begeleiders bestaat. In de toekomst zal het stelsel misschien ook alle begeleiders die nu nog zijn overgebleven hebben verslonden. De grootste maaltijd moet echter nog komen. Het Andromedastelsel koerst namelijk vrijwel recht op ons melkwegstelsel af en zal dit over zo'n drie miljard jaar ontmoeten. Aangezien ons melkwegstelsel echter ongeveer even groot en zwaar is als het Andromedastelsel, zal het even veel van Andromeda proberen te verorberen als Andromeda van ons. Het zal dus nog heftig toegaan aan die kosmische dis.

NRC Handelsblad:
04-10-03

SOHO Saved Again

Antenna failure should have negligible impact on the solar observation satellite

MICHAEL A. TAVERNA/BREMEN, GERMANY

European Space Agency and NASA engineers say an antenna failure will not prevent the SOHO solar observatory from retaining near-full capability until a follow-on NASA mission is ready late in the decade, but warned that the weather-forecasting function could be at risk.

In May, the Solar and Heliospheric Observatory spacecraft suffered a seizure of the East-West (Z-axis) motor on the high-gain antenna (HGA), which serves to transmit instrument data to Earth (*AW&ST* June 30, p. 19). It was the second important glitch with SOHO, after a dramatic gyroscope failure in 1998 that nearly knocked the spacecraft out of service.

Employing double-coil maneuvers, which enabled an augmentation of torque, engineers were able to move the antenna to a "sweet spot" where it could operate nominally most of the time. But recovering full capability was found to carry unacceptable risk and cost trade-offs, said ESA's SOHO project scientist, Bernhard Fleck.

The result is that the HGA is unable to operate beyond a certain path width—8.9 deg., using 26-meter Earth dishes, or 13 deg. with 34-in. dishes—which means it is unavailable 2-3 weeks every three months. For nearly all of the 12 instruments on SOHO, this is acceptable, Fleck said, because the data can be downloaded via the low-gain antenna, which is normally used for spacecraft/payload communications.

However, for two key functions—helioseismology and weather forecasting—the solution is insufficient and could lead to serious problems. SOHO is the main source for data on helioseismology, which studies the interior of the Sun by examining the propagation of sound waves, said ESA's deputy project scientist for SOHO, Paul Brekke. It has also "revolutionized our ability" to predict Earth-bound solar disturbances, he said, which serve to forecast Earth weather and the effect of solar storms on power systems, orbiting satellites and other human activities. Forecasters say there is no alternative currently available.

Engineers are working on a patch to the Central On-Board software program that can resolve the difficulty for helioseismology applications, which require long time series, Fleck said. The software patch would prioritize helioseismology functions when required.

But weather forecasting will hinge on the availability of very large (70-in.) dishes capable of receiving data from the narrow-gain antenna. At present, such antennas have been supplied via NASA's Deep Space Network. But starting in December, the DSN will be largely busy with Mars lander activity. "If the weather forecasting community wants the data, it will have to fight for SOHO access to large antennas," Fleck said.

Nevertheless, engineers insisted that except for these shortcomings and the innermost coronagraph on the Lasco instrument used to study solar flares—lost in the aftermath of the 1998 mishap—SOHO is still functioning perfectly, eight years after launch. According to Michel Bouffard, SOHO project manager at prime contractor Matra (now Astrium), average peak current available is still above 11 amps and solar array degradation just 1.83% per annum, or 14.83% over the 93 months the spacecraft has been in service, primarily due to specific events. Thermal protection degradation is within nominal limits for all instruments, and there is still 120 kg. (264 lb.) of hydrazine fuel on the spacecraft, which is burning no more than 2 or 3 kg. a year.

Officials said this should allow SOHO to remain operational at least until late 2009, when NASA's follow-on Solar Dynamic Observatory is due to be launched. Both ESA and NASA have assured project leaders that money will be available to continue operations beyond 2007, when current budget authority is due to end. The follow-on ESA mission, the Solar Orbiter, will not be sent aloft until 2011-12.

81298

Titan heeft een zee van koolwaterstoffen

81299

De Europese Huygens-lander, die begin 2005 afdaalt naar het oppervlak van de Saturnusmaan Titan, komt waarschijnlijk neer met een plons in plaats van een bonk. Volgens Amerikaanse radarastronomen bestaat het Titan-oppervlak voor 75 procent uit zeeën van vloeibare koolwaterstoffen.

Titan is de grootste maan in het zonnestelsel, en de enige met een dikke dampkring. Dikke smoglagen in die dampkring belemmeren echter het zicht op het oppervlak. Volgens planeetdeskundigen bestaat dat oppervlak grotendeels uit ijs, maar dat gaat waarschijnlijk schuil onder een honderden meters dikke laag van allerlei organische verbindingen die uit de dampkring naar beneden dwarrelen.

Met de driehonderd meter grote radioschotel van Arecibo op Puerto Rico zijn eind 2001 en eind 2002 krachtige radargolven op Titan afgevuurd, waarvan de zwakke echo's ruim twee uur later werden opgevangen. Radar dringt wel door smog en wolken heen, en de radarecho's vertellen dus iets over het oppervlak van Titan.

81300

In driekwart van de gevallen blijkt die radarecho een sterke 'centrale piek' te vertonen, die alleen te verklaren valt door reflectie op een spiegelglad oppervlak. De astronomen, die hun bevindingen deze week publiceren in *Science* (3 oktober), concluderen dat er talloze zeeën en meren van vloeibaar methaan en ethaan op Titan voorkomen.

De Europese Huygens-lander, die deel uitmaakt van de Amerikaanse ruimtesonde Cassini, daalt in januari 2005 aan een parachute af naar het oppervlak van Titan. Gelukkig is Huygens op alles voorbereid: na een eventuele plons blijft hij gewoon drijven.

Volkskrant; 04-10-'03

22392

CNN : 31 AUGUSTUS 2003.

NASA RACES TO CREATE SPACE PLANE .

WASHINGTON - In just five years, astronauts may journey to the International Space Station in a stripped-down four-seater instead of the mammoth -- and aging -- space shuttle. In effect, NASA hopes to commute to orbit in a sleek sedan instead of an 18-wheeler. NASA Administrator Sean O'Keefe announced plans for the Orbital Space Plane before space shuttle Columbia came apart over Texas and killed seven astronauts on February 1. But the tragedy has added a powerful incentive to find a cheaper, simpler and more dependable way to ferry astronauts between the space station and Earth. It's a plan applauded by the Columbia Accident Investigation Board, which chided the nation for not already having a new spacecraft in production. Eventually, NASA hopes to build a next generation shuttle, a more dependable heavy-lift cargo carrier to replace Columbia's three surviving sister ships. But it may be more than a decade before such a craft gets serious consideration. 'A very ambitiously rapid schedule'For now, the space agency is rushing to design, build, test and fly a simple four-person craft that can more cheaply haul people and light cargo to the space station. "The focus is to keep it simple and flexible," said Dennis Smith, the Orbital Space Plane program manager at the Marshall Spaceflight Center. "We're doing everything we can to get it up by 2008." It is, Smith admitted, "a very ambitiously rapid schedule." But he noted NASA pulled off such magic in the early days of the space program. "Mercury, Gemini and Apollo all did things faster than that," he said. The key to the project, Smith said, is to keep the spacecraft simple and use technology that already has been developed. That also makes it cheap. The design phase of the program is budgeted at $2.4 billion, inexpensive by space standards. Smith said the craft will be built with existing technology and existing materials. Some earlier, more ambitious NASA programs required fundamental technical advances that never developed but cost billions. Such a simple approach has been used in the past to create some of the classic designs in transportation. Vehicles such as the World War II jeep and the DC3, a durable air transport that flew for more than 50 years, endured because they were they were simple, flexible, durable, dependable and relatively cheap. Resisting unnecessary bells and whistles The space plane will have only two missions: to carry people up and down from the space station, and to act as a standby lifeboat, parked at the space station for the evacuation of astronauts if there is an emergency. "The two biggest reasons that schedules slip and costs increase is that you change the requirements or you're counting on technology that didn't pan out," Smith said. "That's why we have a very focused set of requirements that we don't intend to change. We're going to set it up for the primary mission of crew rescue and crew transport." He said they are resisting unnecessary bells and whistles and not holding out for "some material like 'unattainium' that isn't in existence." Preliminary studies have settled on some candidate designs. One is flat, resembling a manta ray, with upward folded wings. Others are long and slender, with stubby wings. Those could all land on a runway, as does the space shuttle. Another design resembles a bell-shaped capsule, rather like the craft of NASA's early days. That craft would descend by parachute, the same way the Mercury, Gemini, Apollo and Russian Soyuz spacecraft landed. NASA expects to settle on a final design within a few months. With a capacity of four people, the plane will make it possible for the first time to put more than three long-term residents aboard the space station. Now, the Soyuz, a three-seat craft, is the only escape vehicle available if an emergency develops on the orbiting laboratory. With four more rescue seats, the station could accommodate seven astronauts safely. Smith said the space plane initially will be launched by either Atlas or Delta boosters. These American rockets are among the most dependable, each with decades of success. Later, NASA hopes to develop another booster system. Unique to American spacecraft, the plane will be designed to fly either manned or unmanned. Smith said an auto guidance system will allow the plane to be flown remotely to rendezvous and dock with the Space Station, and then return to Earth. With no humans aboard, the craft could be used to haul light cargo to the orbiting lab.

81301

EURO SPACE PLANE **Europe's largest aerospace company would love to help its U.S. counterparts with NASA's Orbital Space Plane, drawing on the old Hermes project to help meet U.S. requirements for a crew transport that could serve initially as an International Space Station lifeboat. Francois Auque, head of the EADS Space Systems Div., concedes there is no reusable launch vehicle program in Europe today, his company's own Phoenix project notwithstanding. The idea behind the winged Phoenix spaceplane, which has some German government funding, is to "maintain interest" in reusable vehicles. But present funding levels won't lead to a finished vehicle. The OSP, however, is set for major funding as NASA tries to replace the Russian Soyuz vehicles as the ISS crew rescue capability by 2008. "This is a field in which Europe has some experience," Auque says, conceding his company's entreaties have so far fallen on deaf ears in Washington. "Hermes seems to be very close to what the U.S. is targeting today. I don't know if it's necessary to reinvent the wheel. We could be of some help."**

81302

AWST: 22-09-2003.

22393

HOUSTON CHRONICLE : 01 SEPTEMBER 2003.

NASA RACING TO COMPLETE LIGHT CRAFT FOR SPACE TRIPS.

WASHINGTON - In just five years, astronauts may journey to the international space station in a stripped-down four-seater instead of the mammoth -- and aging -- space shuttle. In effect, NASA hopes to commute to orbit in a sleek sedan instead of an 18-wheeler. NASA Administrator Sean O'Keefe announced plans for the Orbital Space Plane before space shuttle Columbia broke apart over Texas and killed seven astronauts on Feb. 1. But the tragedy has added a powerful incentive to find a cheaper, simpler and more dependable way to ferry astronauts between the space station and Earth. It's a plan applauded by the Columbia Accident Investigation Board, which chided the nation for not already having a new spacecraft in production. Eventually, NASA hopes to build a next-generation shuttle, a more dependable heavy-lift cargo carrier to replace Columbia's three surviving sister ships. But it may be more than a decade before such a craft gets serious consideration. For now, the space agency is rushing to design, build, test and fly a simple four-person craft that can more cheaply haul people and light cargo to the space station. "The focus is to keep it simple and flexible," said Dennis Smith, the Orbital Space Plane program manager at the Marshall Spaceflight Center. "We're doing everything we can to get it up by 2008." It is, Smith admitted, "a very ambitiously rapid schedule." But he noted NASA pulled off such magic in the early days of the space program. "Mercury, Gemini and Apollo all did things faster than that," he said. The key to the project, Smith said, is to keep the spacecraft simple and use technology that already has been developed. The design phase of the program is budgeted at $2.4 billion. Smith said the craft will be built with existing technology and existing materials. Some earlier, more ambitious NASA programs required fundamental technical advances that never developed but cost billions. The space plane will have only two missions: to carry people to and from the space station, and to act as a standby lifeboat, parked at the space station for the evacuation of astronauts if there is an emergency. "The two biggest reasons that schedules slip and costs increase is that you change the requirements or you're counting on technology that didn't pan out," Smith said. "That's why we have a very focused set of requirements. ... We're going to set it up for the primary mission of crew rescue and crew transport." He said they are resisting unnecessary bells and whistles and not holding out for "some material like `unattainium' that isn't in existence." Preliminary studies have settled on some candidate designs. One is flat, resembling a manta ray, with upward folded wings. Others are long and slender, with stubby wings. Those could all land on a runway, as does the space shuttle. Another design resembles a bell-shaped capsule that would descend by parachute. NASA expects to settle on a final design within a few months.

81303

NASA to speed up space plane

81304

NASA will accelerate development of the Orbital Space Plane, to be able to launch an International Space Station (ISS) Crew Return Vehicle (CRV) and crew ferry by 2008. The two-year acceleration will mean that by 2010, the OSP will replace the Space Shuttle and the Russian Soyuz TMA spacecraft for ISS crew transportation. Boeing, Orbital Sciences-Northrup Grumman and Lockheed Martin are designing OSP concepts.

The Boeing Company is pulling its new Delta IV booster out of the commercial satellite business. Taking $1.1 billion in charges over a period of seven years, the company has 'eliminated all commercial launches over the next five years', said Boeing's Integrated Defense Systems' chief Jim Albaugh.

This is a result of the downturn in Boeing Satellite Systems (BSS) commercial satellite business, technical difficulties with new BSS spacecraft, extra costs of developing the Delta IV and as a result of its $3.75 billion purchase of Hughes' satellite business in 2000. Boeing has already shed 5000 space and communications employees. The Delta IV will continue to launch government payloads as part of its US Air Force Evolved Expendable Launch Vehicle (EELV) contract.

Lockheed Martin operates the new Atlas V as a result of the EELV contract but has less US Air Force contracts and can only operate from Cape Canvaveral, Florida, whereas the Delta IV has pads at Canaveral for commercial and military satellites and also Vandenberg AFB, California for military launches. Lockheed will now reconsider the plan for a Vandenberg pad. The companies originally estimated that the EELVs would operate in a 50-50 commercial-government market split.

As a result of lack of commercial work, Boeing and Lockheed had been hoping to get more money for the EELV launches.

22394

HOUSTON CHRONICLE : 10 SEPTEMBER 2003.

NASA COULD BUILD NEW CRAFT IN 5 YEARS.

WASHINGTON - Given enough money, NASA could have a new orbital space plane up and running in five years, and the nation's three remaining shuttles eventually could be used only for unmanned cargo missions, NASA's top official told Congress on Wednesday. "It can be done," NASA Administrator Sean O'Keefe told members of the House Science Committee. How much that would cost and whether the White House would back the idea have yet to be determined, O'Keefe said. Speeding up development of a new spacecraft to carry humans to the U.S.-led international space station is among the options being considered by a loosely knit interagency group that is reworking the nation's space policy in the wake of the Feb. 1 Columbia shuttle accident, he said. President Bush's current budget plans call for the proposed spacecraft, which is in the preliminary design stage, to be
operating as an emergency escape pod for the space station by 2010 and as a crew transport vehicle to the orbiting outpost by 2012. Accelerating that schedule would require a major increase in near-term funding, O'Keefe said. "That's gonna cost, and it isn't going to be cheap," he said. O'Keefe declined to provide a cost estimate, saying those numbers still are being crunched. Rep. Joe Barton, R-Ennis, who has been insisting for months that humans should never fly aboard the shuttle again, pushed O'Keefe to come up with the details of what it would cost to get the space plane running by 2008. He also asked for estimates of what it would cost and how long it would take to modify the space shuttles to fly automated missions to complete the station's construction and to deliver supplies to its crew. Barton said he would like to talk with O'Keefe about a fiscal year 2004 supplemental budget request to accomplish those goals. O'Keefe said he would look into the matter and report back. The comments came during a contentious 3 1/2-hour hearing during which Democratic and Republican lawmakers alike demanded that NASA and the White House lay out their vision for future space exploration before Congress signs off on funding for new spacecraft and other projects. Retired Adm. Harold Gehman, chairman of the Columbia Accident Investigation Board, who also testified before the committee, agreed that policymakers should reach a consensus "on what you want to do, then design the vehicle." Gehman's 13-member investigative board released its report last month on the shuttle accident that killed seven astronauts. Democratic members of the committee, including Tennessee Rep. Bart Gordon and Texas Reps. Nick Lampson of Beaumont and Ralph Hall of Rockwall, repeatedly pressed O'Keefe on exactly who is helping the White House develop its space agenda and what ideas are on the table. "Is it like the Cheney committee?" Lampson asked, referring to Vice President Dick Cheney's energy task force that solicited input from the oil industry, including Houston's Enron Corp., as the administration planned its energy policy. The White House has been battling legal efforts by groups seeking more information about those closed-door meetings. O'Keefe said that in this instance, no one outside the administration has been involved in the space policy meetings. But he declined to name those present or to detail the discussions. He said the group would give its recommendations to Bush, who would announce his policy "whenever the president decides." Later, Hall pressed O'Keefe further, joking that Lampson, whose district includes Houston's Johnson Space Center, was "probably upstairs crying" because O'Keefe had failed to answer his question. Reading from a list of names, Hall asked O'Keefe: "Did you talk to the president?" "Yes, sir," O'Keefe responded. "The vice president?" "Yes, sir." O'Keefe said he also had spoken with White House chief of staff Andrew Card "peripherally," as well as Bush's science adviser John M. Marburger III, and representatives of the Departments of Defense and Commerce, and the Office of Management and Budget. O'Keefe said he had not met with White House political adviser Karl Rove, prompting Hall to cross Rove's name off the list. The White House has declined to comment in detail on Bush's space policy and Marburger has refused the Houston Chronicle's request for an interview. Barton's deputy chief of staff, Samantha Jordan, said later that Barton has had no formal meetings with the White House regarding space policy. However, he has spoken often with Bush and other administration officials about his insistence that the shuttle be scrapped as a human vehicle and retrofitted to be flown without a crew to deliver construction components and supplies to the space station. Barton spoke with Bush and Card aboard Air Force 1 en route to Dallas in July, Jordan said, and the president indicated that he would meet with Barton to discuss space policy this fall.

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22395

CNN : 16 SEPTEMBER 2003.

APOLLO-LIKE CAPSULE MAY REPLACE SHUTTLE.

CAPE CANAVERAL - NASA may replace its troubled fleet of space shuttles with a new generation of Apollo-type space capsules, a top space agency official said. "Certainly we have considerable amount of experience flying with capsules," Dr. John Rogacki, director of NASA's space transportation directorate, told Reuters on Wednesday. "One might say on the capsule side it could be that that design experience may lead to a capsule being available sooner than a winged vehicle." Unlike shuttles that land like airplanes, capsules splash down in the ocean and must be recovered by ships. The resurrection of space capsules, which last launched three decades ago, is gaining favor among astronauts, space agency officials and congressional staffers after the shuttle Columbia disaster that killed seven astronauts on February 1. The 13 members of the Columbia Accident Investigation Board were unanimous in urging NASA to replace the aging shuttles as soon as possible by using existing technology and materials. NASA said on Tuesday that the next space shuttle flight, designed to test repairs that might have saved Columbia, would not make a March launch target and might not fly until midsummer. The space agency has spent billions of dollars since the mid-1990s trying unsuccessfully to design a new winged spacecraft, begging the question of whether a winged plane could be delivered by 2008 under a now accelerated timetable. "Boy, I really don't want to speculate on that because I don't want to inadvertently or unintentionally signal to our contractors that I think it is likely or it is not likely," Rogacki said. Waiting for decades Corin Segal, an aerospace scientist at the University of Florida, picked by NASA to design new systems, has estimated that development of the technology to produce a truly safe, winged reusable spacecraft could take 15 to 20 years. Detailed requirements for what has been called an orbital space plane were issued by NASA this week to three contractor teams who will propose designs and compete for the work. For now, NASA is careful to avoid publicly expressing any opinion on what shape the new craft should take, and to stress that there are pros and cons to winged and capsule designs. But NASA spokesman Bob Jacobs said there was no requirement that the craft be plane-like despite its name. "We haven't spelled out that it has to glide back to Earth and land like a plane. That's not a requirement," Jacobs said. The capsule design gained momentum in March from a study headed by astronaut John Young, who has flown in both capsules and shuttles. Young, as well as Michael Kostelnick, head of NASA's human space flight program, cite the versatility of the capsule, which can move beyond low Earth orbit to the moon or beyond. Rogacki said the orbital space plane requirements did not demand the vehicle be capable of deep space travel but that NASA will be looking at its ability to support missions beyond the International Space Station. "There is a great potential for using the orbital space plane system as a basis for future exploration vehicles," Rogacki said. The thermal tiles and wing panels used on the shuttle today could not withstand the heat and stress of trans-lunar re-entries.

81306

HOUSTON CHRONICLE : 23 SEPTEMBER 2003.

NASA SPEEDS EFFORT TO CREATE SPACE PLANE.

81307

NASA plans to accelerate by two years its development of an orbital space plane to take astronauts to and from the international space station, agency officials announced Tuesday. The expedited timetable would make a crew-rescue version ready for docking to the 240-mile-high space station by 2008. Launched aboard an expendable rocket, the initial crewless version could bring four station astronauts back to Earth in a life-threatening emergency. The new plane, along with a Russian Soyuz capsule already moored at the station, would enable the station's 16-nation partnership to increase the number of people living aboard the orbital outpost from three to seven, boosting the manpower available to carry out scientific research. Under the proposal announced Tuesday, a "transport" version capable of carrying four people to the station, as well as back to Earth, could be ready as soon as 2010, although the official target date would remain 2012. "Clearly, this is a vehicle that has to do quite a bit for us," said Dennis Smith of NASA's Marshall Space Flight Center, the program manager. Led byNASA's Washington headquarters, the project will include experts from Johnson Space Center in Houston and Kennedy Space Center in Florida. In its bluntly worded Aug. 26 report on the causes of the shuttle's Feb. 1 breakup, the Columbia Accident Investigation Board urged the White House, Congress and NASA to begin developing a replacement for the 22-year-old space shuttle fleet as soon as possible. The board also urged the agency to design a replacement spacecraft to carry only people and not large cargo, as the shuttle currently does. The large cargo could be launched using unmanned rockets. Efforts to accelerate development of the orbital space plane, which was first proposed by NASA Administrator Sean O'Keefe in early 2002, respond to both concerns. Unlike the shuttles, the space-plane requirements outlined Tuesday include crew-escape systems. During ascent, for instance, the entire space plane might be able to separate from its rocket booster in an emergency and descend safely with its crew. Estimates for the cost of developing the plane range up to $14 billion, according to congressional sources, though NASA said Tuesday it is not prepared to reveal a price tag until President Bush submits his 2005 budget proposal to Congress in February. The White House sought $550 million for the project in the 2003 budget and estimated a five-year cost of $2.4 billion as part of a longer development strategy. On Sept. 10, O'Keefe told the House Science Committee, which oversees NASA, that the project could be accelerated, but added, "That's going to cost, and it isn't going to be cheap." During that legislative hearing and in an earlier interview with the Houston Chronicle, O'Keefe said an acceleration would likely increase the near-term investment rather than the overall price tag. Teams from Boeing Co. of Huntington Beach, Calif., Lockheed Martin Corp. of Denver and Northrop Grumman of El Segundo, Calif., in partnership with the Orbital Sciences Corp. of Dulles, Va., have been conducting conceptual studies for more than two years. In late November, NASA plans to seek bids from the three and award a development contract next Aug. 2. NASA told them to evaluate four concepts: a lifting body resembling an experimental spacecraft that was tested earlier by NASA and the Air Force; a large capsule that resembles NASA's Apollo moon capsule; and a pair of winged spacecraft that look like smaller and sleeker versions of the shuttle. The technical requirements outlined Tuesday appear to favor the lifting body or the capsule concept, though further evaluation is planned, said Smith. Those requirements specify a spacecraft that could be launched aboard a Boeing Delta IV or Lockheed Martin Atlas V expendable rocket from Cape Canaveral. The spacecraft would be capable of autonomous flight and docking with the space station but equipped so astronauts could pilot it as well. The plane would be able to remain parked at the station for up to six months, as the Russian Soyuz does now, and accommodate four astronauts for up to 12 hours if the station has a temporary problem with life-support systems. In the event of an emergency, the plane must be able to depart the station with four crew members within 13 minutes. Currently, NASA plans to continue using the shuttle to assemble and support operation of the space station until around 2020 -- but possibly even longer. The shuttle could prove too costly to maintain and upgrade, including adding a true crew-escape system. Tuesday's announcement was greeted skeptically by U.S. Rep. Nick Lampson, D-Beaumont, a member of the House Science Committee, who questioned whether NASA can meet the accelerated development objectives, and, if not, what purpose the new space plane would serve beyond its space station mission. "If we're going to spend the money, it ought to be more than a vehicle that takes us just to the station and back," said Lampson. The legislator, whose district includes the Johnson Space Center, is the author of proposed legislation that would establish a timeline for human explorers to attempt missions to the moon and Mars

22396

FLORIDA TODAY : 23 SEPTEMBER 2003.

NASA DECIDES GOALS FOR NEW SPACE PLANE.

CAPE CANAVERAL - NASA's next manned space vehicle will have a more capable crew escape system than shuttles and will provide for a quick emergency return to Earth from the International Space Station, officials said Tuesday. The Orbital Space Plane, however, will lack the cargo capacity of the more versatile shuttles and will not provide a platform for station maintenance or satellite deployment and repair work. Instead, a review of system requirements released by NASA show the vehicle primarily will be designed to serve as a less expensive way to launch astronauts to -- and rescue them from -- the international outpost. "This review is a critical step in making the Orbital Space Plane a reality," NASA program manager Dennis Smith said in a statement. "These requirements are the instruction manual for designing the entire system that will provide safe, reliable access to and from the International Space Station." The so-called Systems Requirement Review evaluated preliminary design concepts from three NASA contractor teams. A more formal request for proposals from the teams will be issued in November and a decision to proceed with full-scale development is expected in 2004. In the wake of the Feb.1 Columbia disaster, NASA officials hope to have the new vehicle ready to fly by 2008. The systems requirement review calls for completion "as soon as possible" but no later than 2010. The review focuses sharply on a crew's ability to survive during a launch countdown and flight to and from the international station. The vehicle must be safe enough that no two systems failures can "result in permanent disability or loss of life," the review said. Like the shuttle, astronauts must be able to exit the vehicle on the launch pad and survive an in-flight abort and emergency landing. The spacecraft also must be able to approach and attempt docking with the station at least twice. After reaching the station, the space plane must be able to remain there at least six months to a year and it must offer a "safe haven" from the rest of the outpost should an emergency require astronauts to isolate themselves within it. In an emergency, astronauts must be able to get in the vehicle within three minutes and safely pull away from the outpost within 10 minutes. In addition, the space plane must be able to return to Earth within 24 hours if an astronaut needs medical attention. A risk analysis done as part of the review showed that the space plane likely would be required for at least one rescue mission every four years. The review also calls for a more robust crew escape system than the one currently onboard shuttles. The shuttle system would enable astronauts to use a telescoping pole to bail out of an orbiter but only during controlled gliding flight. The space plane's escape system will be designed to provide "a means for the crew to leave a vehicle in distress during some or all of its flight phases and return safely to Earth," the review said. "The intent is to ensure crew survival, even if the spacecraft is lost."

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FLORIDA TODAY : 25 SEPTEMBER 2003.

FLORIDA VIES TO LAND BUILDER OS SPACEPLANE. STATE AGAINST ALABAMA FOR ASSEMBLY PLANT.

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CAPE CANAVERAL - NASA will choose a site within the next 2 to 3 years for assembling the agency's proposed Orbital Space Plane, which it hopes to fly by 2008. That could mean local jobs and investment. And agency leaders are contemplating two options for the work: near the launch site, Cape Canaveral Air Force Station; or near the project's engineering center, NASA's Marshall Space Flight Center in Huntsville, Ala. It's unclear how many jobs would be at stake or how much money might be funneled into the local economy if the work is done here on the Space Coast. But the states of Florida and Alabama probably will end up in a contest as NASA decides where to assemble components for the new crew transport and rescue vehicle for the International Space Station. "There are two schools of thought," NASA program manager Dennis Smith said in an interview this week. "We need to make a really good decision when we have all the data as to what is the best way to build this system -- the best place." Following the Feb. 1 Columbia disaster, NASA is speeding development of the new space vehicle, which would be launched on an unmanned rocket and serve as a "space taxi" that flies to and from the international station. Capable of carrying four astronauts to the outpost, the new space plane also would serve as an emergency lifeboat at the station, augmenting the capability of a three-person Russian Soyuz capsule that's always moored to the outpost. Florida's state and local economic development agencies already have begun to cobble together a package to woo NASA. They're also making preliminary overtures to the contractors involved. The task of luring the assembly work is made more difficult because the federal space agency has little use for the corporate tax breaks that make up bulk up economic incentive packages. "We're working to come up with creative ways to assist them," said Kim Prunty, spokeswoman for Enterprise Florida, the state's privatized business development arm. "Most state incentives involve a (tax) refund and NASA is obviously exempt from those." Florida has gone up against Alabama before -- and lost. In 1996, Alabama's victory in landing Boeing's assembly plant for the Delta IV rocket project was due in part to a special session of its Legislature to sweeten the incentives. Involved in Florida's campaign is the governor's office, Florida Space Authority and the Economic Development Commission of Florida's Space Coast. "Losing the Delta IV was something to ponder," said EDC president Lynda Weatherman in Rockledge. "I don't feel this is something they will let go so easily." Among benefits that Florida can tout: workforce training before the assembly plant is even built, a new capital investment tax credit, and political punch of a state delegation that has seats on congressional appropriations and space and technology committees. Contractor teams from The Boeing Co. of Huntington Beach, Calif., Lockheed Martin Corp. of Denver and Northrup Grumman of El Segundo, Calif., have been working on design concepts for the new vehicle. Orbital Science Corp. of Dulles, Va., is teamed with Northrup Grumman. About 1,000 people now are working on the project, including 500 NASA civil servants and 500 contractor employees, Smith said. Some $400 million has been spent on the project since it was unveiled last November. Cost estimates for the accelerated completion of design, development, manufacturing, and assembly reportedly range up to $14 billion. NASA's two options for assembly work both have their advantages. Doing the work in Alabama would enable project engineers based at Marshall Space Flight Center to resolve any developmental problems that crop up in a timely fashion. But performing final assembly work at the launch site would cut the cost of transporting the vehicle to Florida from Alabama. In addition, the work would be done by the same people who ultimately will be maintaining and testing the vehicles between flights. "We just need to make the decision as to what's the safest and the most cost-effective way of doing (the work)," Smith said. "You've just got to figure out what's the best way to do it." Smith said the contractors are working on several different concepts, including: A lifting body resembling past experimental spacecraft tested by NASA and the Air Force. Winged spacecraft that would look like scaled back versions of NASA's current space shuttles. A large capsule similar to those launched during NASA's Apollo moon landing project in the late 1960s and early 1970s. The lifting body and capsule concepts are now considered leading candidates, Smith said. The intent is to be able to launch the craft on either Boeing Delta IV or Lockheed Martin Atlas V rockets from Cape Canaveral. Smith said NASA plans to issue a request for proposals from the contractors in November. The winning bidder will be chosen next August. Site selection for final assembly then would come within the following year or so, he added.

22397

Taking Shape

Orbital Space Plane requirements pushing contractors to capsules, lifting bodies

FRANK MORRING, JR./WASHINGTON

The Orbital Space Plane NASA is developing to supplement the space shuttle as a transport and rescue vehicle for International Space Station crews will be 50% more maneuverable in orbit than the shuttle, and could be light enough to launch on a medium-lift version of the Delta IV or Atlas V Evolved Expendable Launch Vehicles (EELVs).

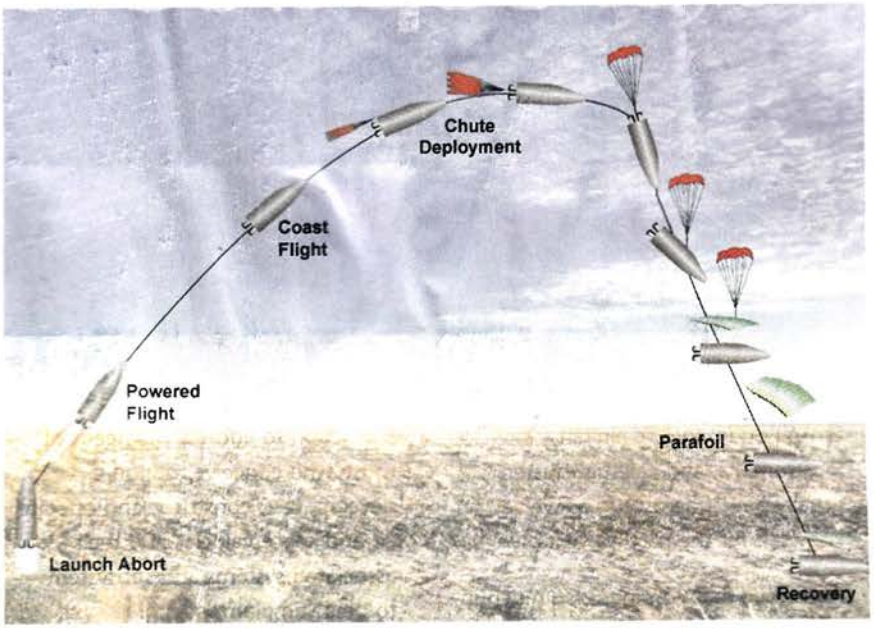
Level 2 requirements for the OSP released in summary form last week give a clearer picture of the sort of OSP vehicle NASA is likely to pick next summer, when the shuttle is expected to return to flight under much more restrictive rules than before the Feb. 1 Columbia accident. It appears that contractors working on OSP concepts have decided the space "plane" will not have wings, but will be a simpler but state-of-the-art ballistic capsule or lifting body that doesn't pose the weight and flight-control problems that wings do on launch.

Lockheed Martin is developing this $53-million "Pad Abort Demonstrator" to wring out safety technology for NASA's proposed Orbital Space Plane.

"We've seen evidence that multiple shapes can meet the requirements, and it's going to take us the next four months to find out which one meets it the best," said OSP Program Manager Dennis Smith. "Then the contractors get to propose why they think that's true. But we have evidence that both a capsule and a lifting body can meet these requirements."

Formal proposals from the Boeing, Lockheed Martin and Northrop Grumman/Orbital Sciences Corp. teams working on the project will be due early next spring, and the program hopes to award a contract in August 2004. If the program goes as planned—and there could be serious obstacles to that on Capitol Hill—the contract will be a big one. While NASA has not yet given a total cost for OSP, congressional witnesses have testified it could range between $9-13 billion. To accelerate the development, NASA and the White House have considered advancing as much as $1.7 billion in OSP funding planned for later in the decade into the near term.

In two telephone press conferences last week on the Level 2 requirements, Smith said budget-planning secrecy restricted him to saying only that the contract would cover development of both the initial ISS crew rescue OSP and the two-way crew transfer version, plus "a couple of years of operations." The Level 2 requirements formally set a target of "2008 or sooner" for launch of an unoccupied OSP rescue vehicle to the ISS on an EELV, with the full-up vehicle to be ready to carry crewmembers both ways "no later than 2012," according to the executive summary of the requirements. The full 250-page document was not publicly released pending export control and security review, NASA said.



ORIGINALLY, THE first OSP flight was planned for 2010. To meet the earlier target, the program is "ramping up pretty quickly," Smith said, and will consolidate civil servant, prime contractor and support contractor personnel in commercial office space near Marshall Space Flight Center in Huntsville, Ala. Currently, about 1,000 people are working on the program, and Smith said he expected that to double over the next year.

NASA settled on a four-person crew for the OSP, after considering 5-8 crew seats as well, Smith said. When combined with a three-seat Russian Soyuz vehicle, the OSP would support the seven-person crew envisioned for the station before NASA terminated its billion-dollar crew rescue vehicle program in the face of station overruns totaling almost $5 billion. That crew size would support the level of microgravity science work NASA used to sell the station project to Congress and its international partners, but the Columbia accident has heightened attention to crew safety in the OSP planning as well.

Smith said that while most of the Level 2 requirements work was finished before the Columbia Accident Investigation Board (CAIB) issued its report, that report has validated the philosophy behind the requirements in many cases. The OSP would also be the first vehicle developed under NASA's new spacecraft human-rating rules, he noted, and will meet FAA requirements for reentry vehicles operating over land. Overall, the program is working to a 1-in-800 chance of catastrophic failure for the vehicle, compared with about 1-in-275 posted for the space shuttle before the Columbia accident. That figure includes the whole system, including the EELVs that will carry both OSP variants to space.

The Level 2 requirements state that "no two failures of the OSP system can result in permanent disability or loss of life," and mandate an abort capability that will lift the vehicle off a failing launch vehicle and return the crew safe-

ly to Earth inside it. There are also provisions for a crew escape system that will enable a crew "to leave a vehicle in distress during some or all of its flight phases and return safely to Earth.

"The intent is to ensure crew survival, even if the spacecraft is lost," the requirements summary continues. "Since physiological impacts vary according to the length of time (duration) at specific acceleration rates and the health of the crew, system requirements also bound the crew environment and acceptable gravitational loads during ascent and reentry."

The OSP program has awarded Lockheed Martin a $53-million contract to develop a "Pad Abort Demonstrator" (PAD) that will subject two instrumented crash test dummies to the stresses an OSP crew would likely face if their launch vehicle failed at liftoff. Set for the first of seven flights at White Sands Missile Range, N.M., in 2005, the PAD would be boosted to about 7,000 ft. by four liquid-fuel rocket engines generating a total of 200,000 lb. of thrust, and return to the ground with a drogue parachute and a parafoil (see illustration p. 27).

While details of specific contractor designs are still competition sensitive, Smith said, some of them weigh in at only about 35,000 lb., light enough to launch on the medium-lift EELV variants. Since plans call for launching on a 50,000-lb. heavy lift (*AW&ST* Sept. 8, p. 48), "there's plenty of room to build capability in," he said.

One new requirement is a 500-fps. improvement in orbital maneuverability over the shuttle, which has a 1,000-fps. capability. In addition to increasing the fuel load, Smith noted that the Space Launch Initiative program—where the OSP originated—developed and tested technology for in-orbit propulsion that could help satisfy the new requirement. That capability could be used to give the OSP a greater choice of landing sites to meet a Level 1 requirement that an injured crewmember can get from orbit to a hospital in 24 hr.

"Some of the lifting bodies out there give you enough cross range to be able to land on a runway," Smith said. "That's not that big of an issue. Obviously a capsule wouldn't, but you can put some additional propellant in a capsule that's essentially equal to the weight of the wings and get almost the same performance if you use orbital mechanics."

The new requirements call for the OSP to be able to deliver a crew to the ISS within 24 hr. of launch, but with the capability to support a crew for three days if the first docking attempt goes awry. It must be capable of both autonomous and manual docking at the ISS, whether or not the station is occupied. In an emergency, it must provide an attached "safe haven" independent of station life support for 12 hr., with the crew able to get into the vehicle in 3 min., and to separate from the station and begin the return to Earth in 10 min. Counting on four crew transfer missions to the ISS a year, the requirements cite the need for one rescue mission every four years based on probabilistic risk analyses of medical data derived in part from Antarctic operations.

The OSP must be able to dock and function at either the port or starboard ports of the planned Node 3, and to remain there as a lifeboat for as long as six months. Smith said the vehicle would be outfitted to carry cargo when it is launched to the station without a crew, and equipped with handholds and other equipment to support extravehicular activity originating on the station. But it would not have an airlock or robotic arm since those capabilities already exist on both the station and the shuttle.

"The key thing is that it really drives it to a simple, focused solution," Smith said of the new requirements document. "We didn't try to turn it into something that can do everything for everybody."

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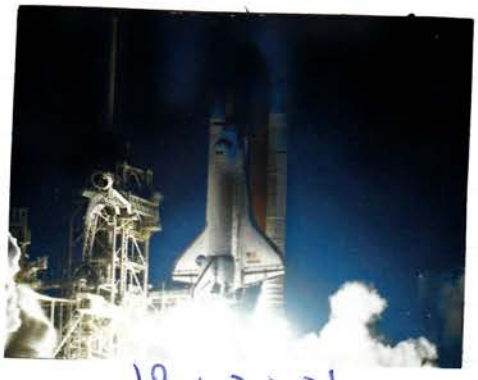

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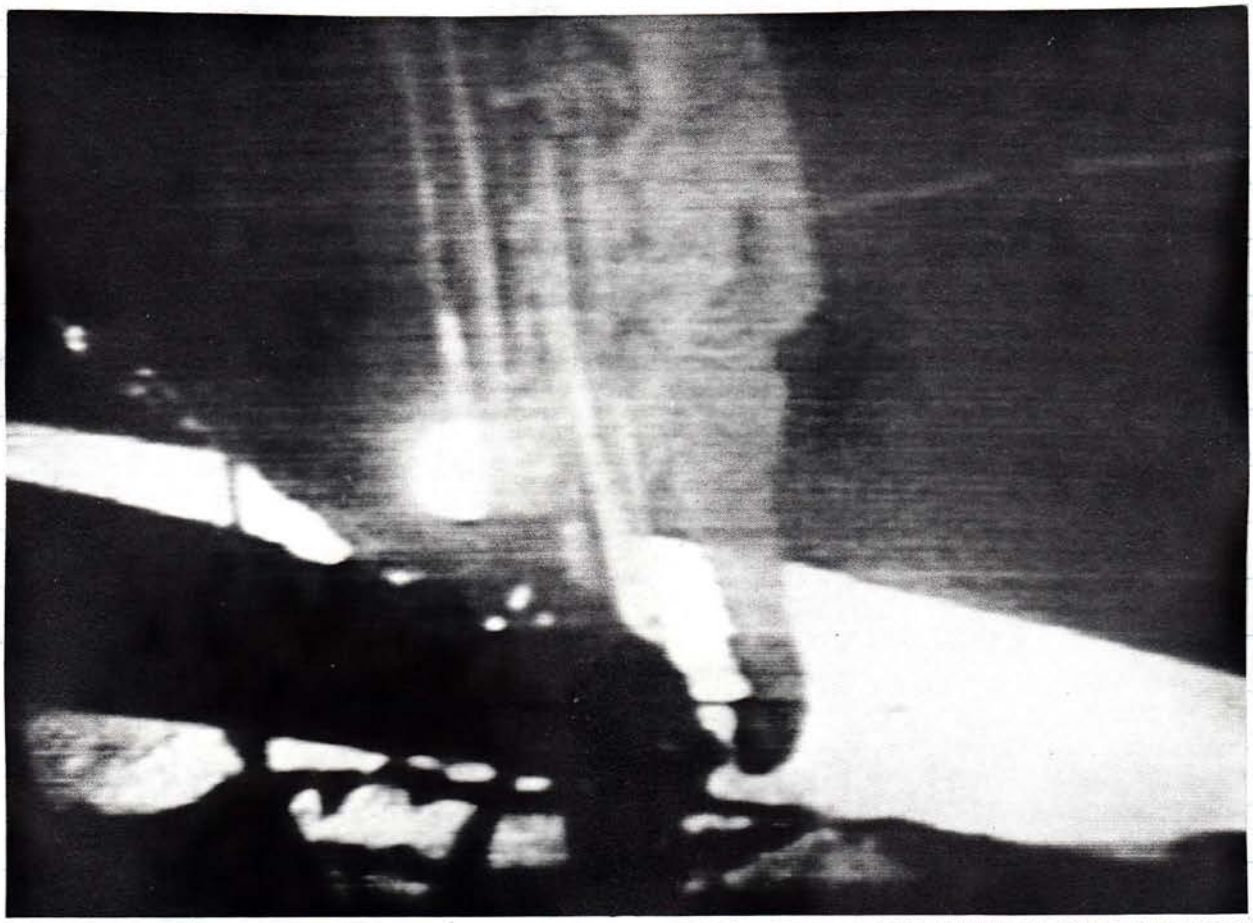


We Walk On Moon
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The Philadelphia Inquirer
MAN LANDS ON MOON
'Eagle Has Landed,' Astronauts Say


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ASTRONAUTS LAND ON A PLAIN AFTER STEERING PAST CRATER
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Daily Press
The Washington Post
Apollo Sets Course For Hon
After Perfect Lunar Takeo
Eagle Begins Trip Home
TO THE MOON...AND BACK
COMING HOME
No one knew it when Columbus first stepped on Wattings Island, but every headline writer was challenged by the first manned Moon landing. The full newspaper coverage suggested by these front pages was just a part of it. Considering the nearly worldwide radio and television coverage, it has been estimated that more than half the population of the planet was aware of the events of Apollo 11.

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