Shuttle, Telescope Woes Undermine NASA's Plans

Problems with the shuttle and space telescope come at a most inopportune time—just as the 1991 budget takes shape

THE DUAL DEBACLE suffered by the National Aeronautics and Space Administration at the end of June has come at a singularly inopportune time for the space program. NASA is in the midst of trying to persuade Congress to approve a $15-billion budget for next year that includes the first installment of funds for a grandiose plan for manned exploration of the moon and Mars. Instead, it finds itself explaining how a crippling defect occurred in its high-profile Hubble Space Telescope and why, after all the redesign that followed the Challenger accident, a hydrogen leak in two orbiters has grounded the shuttle fleet (see pages 112 and 116).

The continuing problems with the shuttle, in addition to damaging NASA's credibility, could cause immediate problems for science missions waiting in line for launch that have not been shifted to conventional rockets (see chart). But they also raise doubts about NASA's ability to get the $30-billion international space station up and running without sacrificing all its resources to that goal. Some congressmen are worried that the shuttle's performance may be a preview of things to come.

Legislators know that R&D projects have start-up troubles, but some found it hard to take these setbacks with grace, knowing that both the shuttle and the space telescope have been in development for more than a decade. Members of Congress went off on their 4th of July holiday muttering about "techno-turkeys" and threatening to clip NASA's wings. There may be more bad news to come—in the form of investigations, cross-examinations, and finger-pointing—as Congress returns to work on 10 July.

Senator Barbara Mikulski (D–MD), who chairs the NASA appropriations subcommittee, said she was "outraged" by NASA's failure to get the telescope to focus properly after spending more than $1.5 billion on it. She scheduled a hearing tentatively on 18 July. Senator Albert Gore (D–TN), chairman of the Senate authorization subcommittee, grilled NASA witnesses in a preliminary inquiry on the Hubble Telescope on 29 June, but did not get to the source of the problem. The NASA authorization committee in the House, chaired by Bill Nelson (D–FL), will take its shot on 13 July.

Meanwhile, these troubles may cool what little enthusiasm there is in Congress for the Administration's plan to launch a new venture called the moon-Mars mission—or, in official terms, the "Scientific Exploration Initiative" (SEI). The goal is to build a U.S. base on the moon and transport humans to Mars by 2019, cost unknown. President Bush has been promoting the idea heavily in speeches, but so far he has made little progress. The House appropriations committee cut NASA's request for getting SEI started from $188 million to zero, and on 28 June the entire House passed an appropriations bill that endorsed that decision. On 27 June, the Gore committee in the Senate also voted to eliminate SEI. Senators Gore and Ernest Hollings (D–SC), chairman of the parent commerce committee, declared that they strongly oppose starting any such program at this time. Another key player, the Senate appropriations subcommittee, hasn't yet taken up the NASA budget and probably won't before September. But SEI doesn't appear to be a high priority.

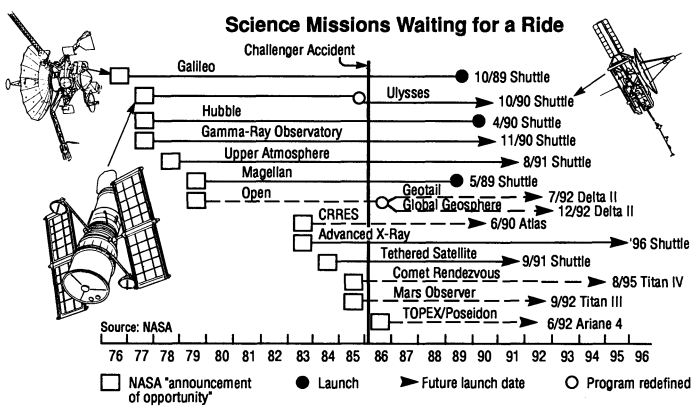
But this congressional debate is academic in one sense: NASA has some unfinished business around the home planet to complete before going off to Mars—including taking a backlog of scientific payloads into orbit.

Among these regular NASA clients, the impact of the shuttle delay has been slight so far, but could become severe. If the leak is identified and fixed without a complete redesign of the part, it may cause only a hiccup in the schedule: the shuttle may complete seven rather than nine planned flights this year. But if NASA finds a critical design flaw, the schedule may be torn to shreds and one science payload will be set back more than a year.

The threatened spacecraft is the long-delayed Ulysses probe, designed to fly in a polar orbit around the sun and collect data on solar wind and the sun's corona. It was meant to be launched on the shuttle in 1986, but the Challenger disaster and cancellation of a secondary booster rocket that would have carried it into high orbit put it on the sidelines. Had it been designed to fly on a regular rocket—an expendable launch vehicle (ELV)—it would have been on its way years ago. But because Ulysses now lacks a strong secondary booster and is tied to the shuttle, it must wait for the right alignment of planets to get a gravity boost from Jupiter. That "window" occurs only once every 13 months, so if Ulysses misses this chance it will have to wait until 1991.

After the Challenger accident, NASA made a soul-searching review of its plans for launching future payloads and decided, as several other reviewers did, that it should reduce dependence on the shuttle. NASA adopted "a mixed fleet policy" that moved many spacecraft off the shuttle and onto ELVs. Unmanned rockets may have greater odds of failing than the shuttle, but, because they are robot-driven, they are also more likely to be launched on time. In a few cases payloads were reconfigured for ELVs. Thus, the U.S.–German Roentgen satellite (ROSAT), an x-ray observatory, rode into orbit on a Delta II rocket in June without a hitch. Now it's sending back data. The Cosmic Background Explorer (COBE) was modified for $30 to $40 million to fit on a Delta II rocket and went into orbit in November.

Other spacecraft being planned for the future were shifted from the shuttle to ELVs if possible, according to Darrell Branscome, director of NASA's launch policy review. One way or another, he says, the backlog is being reduced. Branscome figures the average delay has dropped to about 1 year. The payloads still waiting for a shuttle ride are those too heavy to fly on any other rocket, those that would cost too much to modify, or those that might need a crew to make last-minute adjustments.



Not everyone thinks NASA has done enough, however. An aide to a congressional committee says the shuttle payload list could still be trimmed by 40 to 50%. For example, he says the large data relay satellites (TDRSSs) could be modified for about $2 million each to fit aboard the powerful Titan III rockets used by the military. The TDRSS, says Ray Williamson of the U.S. Office of Technology Assessment, "is a beautiful example of a satellite that never needed to be on the shuttle."

Although NASA may soon get the shuttle up and running, the fuel leaks and prolonged stand-down do not inspire confidence for the big role the shuttle will soon be playing. In a series of 19 to 26 flights beginning in 1995, it will be required to run with unparalleled regularity as Space Station Freedom is assembled and supplied on orbit. The job may be made easier when a fourth, brand new orbiter is completed in 1992. But recent risk analyses make clear that the chance of a major setback will remain high.

For example, a December 1989 study for NASA by L Systems Inc. of El Segundo, California, found that, with a fleet of four orbiters, the chances are 50–50 that a shuttle flight to the station will fail. Based on the record so far, the overall risks of a "mission failure" (with or without death of the astronauts) is greater than 1 in 100. The findings trouble some observers, including Jerry Grey of the American Institute of Aeronautics and Astronautics. He points out that NASA has no contingency plan to replace a space station segment if one is lost on its way into orbit, even though the chances of this happening are large.

Many people have proposed solutions to NASA's transportation problem. The trouble is that all of them require "new" federal money, a scarce commodity right now. A robot version of the shuttle, called shuttle-C, could be built in 4 to 5 years for about $1.5 billion, NASA says. It would be tremendously helpful in building the space station, but might have few other uses. Another idea that is getting attention at the White House is the program to create an "advanced launch system"—more efficient and more reliable than the shuttle, but more expensive to develop than shuttle-C. NASA and the Air Force are working together on this project, but the Administration's funding requests for it were lower for 1991 than for 1990, and Congress seems even less interested at the moment. This idea is a long shot, and an underfunded one at that.

NASA's immediate challenge for the 1990s, therefore, is the same one it has had since the 1970s: to get the shuttle running.

■ ELIOT MARSHALL

A Leaky Mystery for NASA

When you have a leaky pipe, how long does it take to find the hole? If you're NASA and the pipe in question carries liquid hydrogen at a temperature of about 16 K, the answer seems to be, quite a while. Nearly 2 weeks after detecting a hydrogen leak in the space shuttle *Atlantis* (and 6 weeks after grounding *Columbia* for the same reason), NASA engineers identified a "primary suspect"—the main seal in the 17-inch fuel pipe connecting the orbiter to its external fuel tank. But the agency has been unable to explain exactly where the leak is—much less how it came to be or how to fix it.

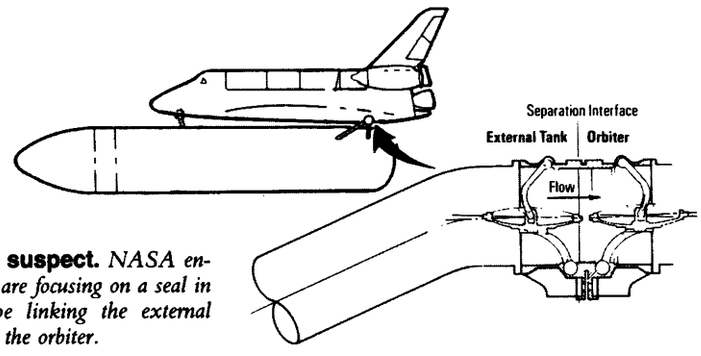
The leak was first detected on 29 May, when liquid hydrogen from *Columbia*'s fuel line flooded the engine compartment of the orbiter. The shuttle was rolled back into its hangar and disassembled for testing. Then, on 29 June, engineers pressurized the external fuel tank on *Atlantis* in a special fueling test. It, too, sprang a leak, leading NASA officials to ground the entire shuttle fleet while they assessed the problem.

High on the list of suspect components has been the 17-inch pipe's "quick disconnect," which lies in the middle of the pipe between the external tank (ET, in NASA parlance) and the orbiter. When the ET is jettisoned during the shuttle's ascent, the disconnect is responsible for closing valves on both sides and then separating cleanly. In the present case, it appears that the disconnect's main seal—a 0.231-inch-thick teflon ring—may have somehow been dislodged from its milled groove, allowing hydrogen gas to escape during fueling. This diagnosis is preliminary and somewhat speculative, however.

In a best-case analysis, NASA would locate an easy-to-fix leak, fix it, and launch the next shuttle (which would probably be *Atlantis* and its secret military payload) within a month. No one at NASA is predicting such a schedule, however, and nobody is even willing to guarantee that the Ulysses solar spacecraft will be able to get off through a narrow launch window in October. Engineers won't even be prepared to find the exact source of the leak until 13 July, when they set up test stations on *Atlantis*'s launch pad at the Kennedy Space Center. In subsequent "baggy" tests, engineers will place plastic bags around each potentially leaky joint, pressurize the fuel lines, and then measure the hydrogen concentration within the baggies.

Only then will NASA be able to address the question of the hour: does the leak result from a previously unnoticed design flaw? NASA officials profess agnosticism on the subject, but are quick to point out that the disconnect has worked well for more than 30 shuttle missions. Even so, disturbing details about the design and testing of the disconnects keep surfacing. One set of eight ET-side umbilicals manufactured in 1984 failed an initial pressurization test with a "slave unit" simulating the orbiter connection—and two of the eight are now mated to *Columbia* and *Atlantis*. William Lenoir, NASA's associate administrator for space flight, says, however, that the initial test failure was attributable to problems with the slave unit and they all passed a subsequent test. These tests were also performed with liquid nitrogen rather than more volatile liquid hydrogen, itself a questionable procedure. "Testing with liquid nitrogen doesn't tell you anything but whether you have gross hardware failure," admits Robert Crippen, director of the shuttle program. Another sobering thought: the ET-side of *Columbia*'s disconnect failed a stand-alone liquid hydrogen test just last week. While about 300 times smaller than the original leak (and therefore probably unrelated), this failure suggests that the shuttle may have more problems than a single leaky seal can explain.

■ DAVID P. HAMILTON



Prime suspect. *NASA engineers are focusing on a seal in the pipe linking the external tank to the orbiter.*