The Domino Effect: How Serious Is The Shuttle Delay and What Harm Can It Cause?

By James Oberg

It wasn't officially a "grounding," but two days after a glorious "return to flight" on July 26, officials said NASA's space shuttle fleet would not fly again until the vehicle's persistent foam-shedding faults were fixed. At least two significant fragments of insulation had torn off during launch, and a smaller piece had veered so close to the right wing that it might well have scraped it.

Within the shuttle program, space workers were generally resigned to redouble their efforts to complete the safety upgrades that would reduce flight hazards to a tolerable level. But other emotions were mixed in to varying degrees. There was a lot of startled gloom, for some to the extent of dusting off professional résumés. There was some helpless anger—most of them had done their jobs perfectly, but some of their teammates had apparently let the home team down. (There was even some gung-ho flamboyance: claims that all it would take was glue and baling wire to get the spaceship cleared to fly again.)

At press conferences, shuttle program manager Bill Parsons was repeatedly interrogated about the possible time frame of the predicted delays. He refused (properly) to make any quantitative reply, but at one point remarked that the delay "might be one month, it might be three months," but didn't speculate anything longer than that.

NASA Administrator Mike Griffin spoke to newsmen four days into Discovery's mission and refused to take either the September of November launch windows off the table. But at another press event that same day, Richard Covey, co-leader of the team that assessed NASA's compliance with the recommendations of the Columbia Accident Investigation Board, said he saw the need for more fundamental research into "the phenomenon and the physics" of foam lost in order to better understand the theoretical basis of the shedding problem. Such a research program, perhaps involving complex wind tunnel and aircraft flight tests, could take a significant time. However, Covey added he did not think it would be anything like the gap between Columbia and the recent RTF.

Sadly, past delays in solving engineering problems that had grounded the fleet turned out to be significantly longer than initially expected. The first flight on April 12, 1981, was more than two years late. Even after Challenger was lost in January 1986, and then Columbia in February 2003, shuttle managers initially believed they would be flying again within four months. Yet both times, it took about two and a half years to get off the ground again.

There was an additional scheduling flaw that may cast light on today's problem. In both cases, during the time the fleet was grounded, managers kept believing—and acting on—the idea that they would resume operations within six to eight months. This delusion led them to reject many serious repair and upgrade proposals that would have been very effective but would have needed more than 12 months to implement. Convinced there wasn't enough time remaining before the next launch, management regularly turned down such recommendations.

Armed with 60/60 hindsight, and with the experience of seeing how long the last effort took to redesign and re-verify the shuttle's fuel tank, I've collected the "best guesses" from space program veterans. The range of their estimates doesn't suggest "one month" or "three months," and rarely included any dates within this calendar year. Optimists hope that a new mission could be mounted early in 2006, although the middle of the year seemed more likely to them. That's a delay of 10 to 12 months or perhaps more.

Investigators will be using this time to dissect another existing external tank (perhaps the one originally slated for STS-114) to examine the true state of the bonds holding insulating foam onto the metal hull. Few observers, even dedicated space buffs, realize that most of the insulation on the tanks that were shipped to Florida were installed in the year prior to the Columbia disaster, and do *not* reflect any "redesigned tank" at all.

Return to Fright: Gaps in the insulation foam on Discovery's external tank show foam loss from the tank's Protuberance Air Load (PAL) Ramp. A foam impact led to the destruction of the Columbia shuttle during re-entry on February 1, 2003. *Image Credit: NASA*

Once a diagnosis is reached, a variety of treatments must be developed and tested. Sample applications will be made on test-beds, which will be subjected to rigorous environmental conditions, before being dissected again. Whichever process is ultimately selected—STS-114's tank has different areas where failures indicate the need for new but different technical solutions—must then be implemented in a process under strict control. Only then will a flight-ready external tank be available for shipment to Florida in preparation for a new shuttle launch.

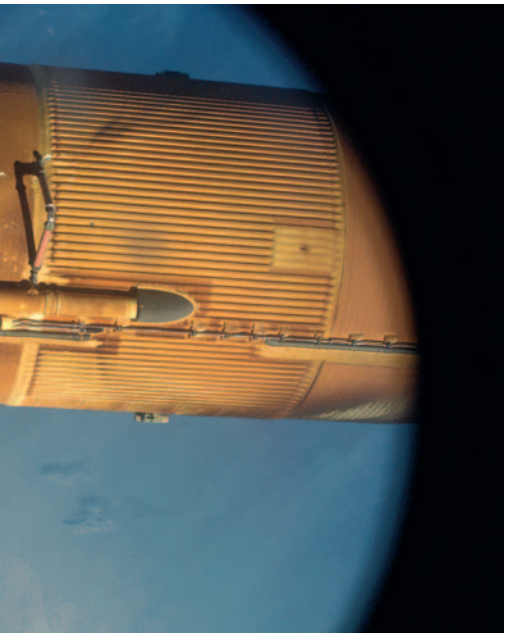
There's probably no "pixie dust" solution that will make the tanks currently in Florida suddenly acceptable through piecemeal local surgery. Even transportation efforts alone will take months. Any suggestion to simply "jury rig" existing foamed tanks will be greeted with the extreme skepticism it deserves.

But the notion that the next shuttle mission, STS-121 by Atlantis, will not occur in this calendar year is sending ripples throughout the International Space Station (ISS) program, Washington-Moscow diplomacy circles and the science community as the future of the faltering Hubble Space Telescope becomes ever more in doubt.

A flawless Discovery mission was always expected to be critical for the ISS. Spare parts and crew supplies had been running short, and the list of important repair work had grown long. With the prospect of a longer-than-expected hiatus until the next mission, the crew squeezed out extra equipment and supplies from the shuttle to further restock the station.

The planned second mission is officially designated ULF 1.1, which stands for the "utilization and logistics flight" that was belatedly inserted between the scheduled UF-1 and UF-2 missions. Like STS-114, it had a pressurized cargo module installed in the payload bay. That module was to carry more supplies and spare parts, along with several complex equipment racks for the U.S. Laboratory Module.

The "second wind" that STS-114 provides to the station should be able, with continuing supplements from Russian robot supply ships, to carry the station well into 2006. Sometime in that time frame, the first flight of the European robot transport craft (the ATV, for "Automated Transfer Vehicle") should occur—and just in time.



As with the Russian supply ships, the ATV can carry only equipment that can be passed through the 30" tunnel from the docking port on the end of the Service Module. Currently, the cargo on the first ATV (code-named Jules Verne) is focused on enhancing the scientific capability of the station. But if the shuttle launch delay extends into 2006, the Europeans will need to almost completely reload their ship with more urgently needed crew supplies and generic spare parts.

One other item of '"space cargo" is going to be removed from near-term flight manifests. His name is Thomas Reiter, and he currently is slated to ride the second shuttle mission to the station—where he would be left behind. The reinvigorated station was supposed to by then be able to handle the baseline three-person crew instead of the two-man skeleton crew that has been the rule for more than two years.

If Reiter doesn't get transferred onto the space station later this year, another important transfer will also be delayed. This is the bank transfer from the European Space Agency to the Russian Space Agency, to pay for Reiter's slot on the station.

Officially, it is a "Russian slot," according to long-standing agreements among the international partners. The Europeans agreed to pay tens of millions of dollars to occupy the slot instead, and the Russians have doubtlessly budgeted that cash into their own spending plans for late 2006. Without it, other important space projects may not be adequately funded.

NASA will have its own astronaut flight slot crisis late this year if shuttles aren't flying again until later in 2006. The Soyuz slated for October, carrying cosmonaut Valeriy Tokarev and astronaut Bill McArthur (and paying "space tourist" Gregory Olsen), is the last time the Russians are obligated to carry NASA personnel for free. Beginning in 2006, all seats on Soyuz missions will be assigned on a purely cash-and-carry basis. But NASA is forbidden by law to buy any such goods and services from Moscow.

NASA had developed a plan to dodge this problem by transporting all its future space station crewmembers aboard shuttles. McArthur himself was slated for a shuttle return a month after the Soyuz he launches on returns next April (a scheme that would have given him the American mission duration record). The Russians would still keep "emergency bailout seats" available to U.S. station astronauts on a barter basis with occasional Russian rides on space shuttles, but would not carry any Americans up or down under ordinary conditions.

Those deals, or course, are voided by a substantial new shuttle delay. Instead, NASA will need supplemental appropriations to buy the space transportation services, and it will need congressional clearance to evade the legal constraints that forbid such payments. Officials have known about this impending crisis for years but had developed elaborate schemes to dodge it—schemes that are no longer workable.

Another fatally wounded scheme that had until now merely been dying would be the 28-mission manifest for the last five years of the shuttle program. Slated for retirement for safety reasons by 2010, the shuttle fleet is also supposed to complete station assembly—at least to the point that expendable rockets and foreign space vehicles can keep the station functioning until a new generation of American space transportation tools come on-line.

With the clock ticking through months and months of no shuttle missions, and the adamantine drop-dead date of 2010 looming guillotine-like on the horizon, we will most likely see more and more of the major elements of the station shift to expendable rockets. The Russians are developing a space-to-space tug called "Parom," assembled from off-the-shelf spacecraft components that will be able to dock to station-bound payloads in parking orbits and haul them up to the station, but for a fee. It may be a bargain.

Parom is a Soyuz-sized "flying tunnel," with docking mechanisms and rendezvous sensors at both ends. Based at the space station, it would await the launching of large components or cargo canisters into low, parking orbits. Parom would also arrange to dock with Progress tankers, or with propellant supplies launched inside some of the cargo modules, to top off its own tanks as needed. It could handle, according to its designers, cargoes ranging in size from a few tons all the way up to shuttle-sized cargo unit of 30 tons.

Even beyond the station program, a major shuttle delay will have serious repercussions. It may, for example, crush any renewed hope in rescuing the faltering Hubble Space Telescope. NASA administrator Griffin had expressed support for the insertion of one repair mission into the shuttle flight plan, but only after about half a dozen critical components had been installed.

That would have happened sometime in 2008, perhaps, with a good chance of getting there before the telescope's control systems break down. Now the odds of the mission arriving in time have dropped dramatically—raising the frightening possibility that the telescope itself will literally fall dramatically out of the sky.

So the fluttering fragments of Discovery's fuel tank, broadcast last July over and over again in the days after a triumphal launch, may not just show the collapse of confidence in the new, improved space shuttle. They may also be premonitions of a widening circle of impact on other space projects.

Those prospects in turn may put pressure on shuttle engineers to develop another 'quick fix"' that will only take the amount of time managers think they can afford—instead of the time actually required. And if that unspoken schedule pressure influences engineering judgment, it will harm not just the space hardware, but the soul of the space industry culture back on Earth. Now is the time to be particularly alert to such subtle seductions, and to resist them no matter what the short-term cost to beloved projects.