

# The Columbia shuttle tragedy: Lessons of the Challenger inquiry

Shannon Jones  
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The initial phase of the inquiry into the Feb. 1 destruction of the Space Shuttle Columbia reveals the systematic erosion of safety standards in the space program and the enormous strains on the space agency resulting from its subordination to commercial interests and the Pentagon.

The inquiry has substantiated the likelihood that the cause of the disaster was insulation from the Columbia's fuel tanks breaking loose and damaging the thermal shield on the left side of the space vehicle. Investigators think that hot gases may have penetrated the breach in the thermal shield, causing the breakup of the shuttle during reentry.

The loss of the Columbia and the death of its seven astronauts followed numerous warnings about the safety of the shuttle program. Just months before the tragedy a retired NASA engineer wrote president Bush several letters warning of safety problems with the shuttle. He urged a moratorium on shuttle missions, citing a multitude of system failures.

An internal NASA memo written the same year spelled out 30 "high risk" concerns about the shuttle's external tanks and quality control problems with insulating foam. It warned specifically about the potential for a "missed flaw" leading to "failure in flight."

A report submitted to Congress that same year complained that NASA was understaffed and that employees were "overworked" and "fatigued." In March of 2001 NASA's Aerospace Safety Advisory Panel issued a report stating that work on long-term safety issues had deteriorated. NASA responded by dismissing five panel members and two consultants.

In the first public hearings held after the loss of the Columbia, Jefferson Howell, the director of the Johnson Space Center, expressed concern over the effects of privatization. He testified that of 10,000 people employed at the space center, only 3,000 were NASA employees. The rest were sub-contractors. He warned that the number of NASA employees would fall even further.

Ron Dittmore, the program director of the space shuttle, told panel members that since 1993 the space agency had lost 50 percent of its civil service technicians and the program was "slowly losing the checks and balances and healthy tensions" required to ensure safety. Several weeks later Dittmore announced his resignation from NASA.

Despite, or more accurately because of, the wealth of evidence implicating the White House and top NASA officials in the deliberate sacrifice of safety in the interests of their corporate-driven agenda, the inquiry into the Columbia disaster promises to be a cover-up, in which none of the crucial issues will be seriously explored.

The Columbia Accident Investigation Board itself is made up largely of space agency insiders, with most panel members designated by NASA Administrator Sean O'Keefe. Heading the board is retired Navy Admiral Harold Gehman Jr, former supreme allied commander of NATO. About half the board members have military backgrounds. Gehman said the board's charter excludes it from assigning blame or culpability. Gehman also said that the board "may give witnesses privileged status," allowing their names to be kept secret. "We want to find the causes of this, not the guilty parties," he added.

The destruction of the Columbia leaves NASA with three shuttles remaining out of the total of five built. The space shuttle Challenger exploded after lift-off, killing all seven crewmembers in January 1986.

The record of the Challenger disaster and subsequent investigative cover-up bears close examination in light of the ongoing Columbia inquiry. The events leading up to the destruction of the Challenger manifested the same intense pressures on NASA staff and a similar pattern of disregarded warnings culminating in tragedy.

The Challenger explosion was the worst setback to the US space program up until that time. It was witnessed by millions of people both on the ground and through live television broadcast. The flight crew included the first teacher in space, Christa McAuliffe.

President Ronald Reagan appointed a commission to investigate the loss of the Challenger headed by former Secretary of State William Rogers. The 20-member panel included individuals from a broad range of professions. Among the panel members were former astronaut Neil Armstrong, the first man to walk on the moon, and Nobel Prize-winning physicist Richard Feynman.

From the outset the commission confronted evidence showing that NASA officials ordered the launch to go ahead despite safety warnings. There were charges that the White House had intervened to prevent further delays in the launch so that it would coincide with Reagan's State of the Union speech to Congress set for that evening. NASA had submitted to Reagan a paragraph to be included in the speech saluting McAuliffe.

The blasting of human beings into earth's orbit aboard an explosive-laden rocket at enormous speeds is an incredibly complex and inherently risky undertaking. The destruction of the Challenger involved one of the largest non-nuclear explosions in history, the equivalent of nearly 1000 tons of TNT.

The apparent nonchalance of NASA officials about safety was appalling. In the final analysis it reflected pressures to maintain an impossibly ambitious launch schedule set by the military, which saw the shuttle as the cornerstone of Reagan's "Star Wars" program, as well as pressures from NASA's corporate clients.

Budgetary and political pressures affected the ultimate design of the shuttle. Following the successful moon landings the NASA budget had been under steady attack, resulting in pressures to lower design standards in order to cut costs. In order to justify its budget, NASA had to demonstrate the space program's military value. This required design modifications affecting the safety and landing capabilities of the space vehicle.

The Challenger commission soon established the immediate cause of the disaster, the failure of the rubber like O-rings joining the sections of the solid rocket boosters. Feynman established that the O-ring failed due to record cold temperatures at the time of the launch.

To dramatize this, the physicist dipped an O-ring into ice water during a televised session of the commission. The O-ring immediately became

brittle. The lack of resiliency of the O-rings at relatively low temperatures prevented them from sealing properly, thus permitting hot gases to escape, resulting in the emission of a flame from the side of the booster. The flame caused the main external fuel tank to explode 73 seconds into the launch.

Documents produced in the course of the inquiry showed that the O-rings had long been a source of concern. The basic design of the solid booster rocket had been criticized as unsafe as early as 1972-73, when the shuttle was in its planning stages. In fact solid rocket boosters were not used during the first 20 years of the space program because they were considered too risky. However solid rocket boosters had the advantage of requiring a smaller smaller outlay for research and development than did safer liquid fuel boosters.

Once NASA accepted the plan for a solid rocket booster it attempted to cut costs further. It rejected a bid for the construction of a one-piece solid rocket booster that would have eliminated the need for O-rings. It instead accepted Morton-Thiokol's less costly plan for an SRB built in segments. Political horse trading also played a role. One reason that Thiokol's bid was ultimately accepted was the fact that the chairman of the Senate committee overseeing NASA's budget came from Utah, the home base of Thiokol.

With the start of shuttle missions in 1981 the O-rings continued to cause concern. A document in 1982 warned that the seals were a potential source of danger. In fact, during several launches of the shuttle there had been significant erosion of the O-rings.

A NASA study warned that flight safety was "being compromised by potential failure of the seals." It warned that "failure during launch would certainly be catastrophic." Another report received by NASA two years before the Challenger explosion pinpointed the solid rocket boosters as the most dangers component of the shuttle. It estimated the risk of a catastrophic failure of the solid rocket boosters at 1 in 35.

While NASA required all shuttle systems to have fail-safe backups, in the case of the O-rings it made an exception.

There were other safety concerns. Members of the Aerospace Advisory Panel had warned about a too ambitious launch schedule. Crews routinely worked seven-day weeks and 10- and 12-hour days. Pressure for more frequent launches was especially intense from the Pentagon, which used the space shuttle for lifting spy satellites and research for Reagan's "Star Wars" program aimed at developing an anti-missile system.

Record low temperatures were expected at the time of the Challenger's launch, which had been re-set for January 28 after two previous delays. The overnight low temperature was 23 Fahrenheit degrees and launch time temperature was expected to be 38 degrees. The previous coldest launch temperature had been 53 degrees. In the hours before the fatal launch, engineers from Morton-Thiokol warned NASA officials about the potentially dangerous effects of cold weather on the solid rocket boosters and particularly the O-rings.

The effect of cold on the O-rings was not known at the time. However, the O-Rings from a shuttle flight launched under cold conditions the previous year showed significant erosion. Morton-Thiokol engineers were convinced that cold weather would decrease the elasticity of the O-Rings, which might impair their ability to seal properly, and thus could allow hot gases to escape through the joint.

Reacting to intense pressure to go ahead with the launch, officials at the Marshall Space Flight Center took the unusual step of asking Morton-Thiokol to prove that launching the shuttle was unsafe. Normally NASA demanded the opposite, i.e. that subcontractors prove a system was safe. When the engineers stuck to their position that launch conditions were unsafe, Morton-Thiokol management, not wanting to cause problems for a high profile customer, overruled them and gave NASA approval to launch.

Rockwell International, the manufacturer of the orbiter, also expressed

concerns about launching in cold conditions. Its engineers warned that ice from the shuttle or the launch platform could fall and damage the spacecraft. However, under management pressure, Rockwell engineers toned down their warnings, merely asserting that they could not guarantee the safety of the shuttle.

NASA management was determined to press on with the launch under any circumstances. Having browbeaten its subcontractors into giving qualified approval for the launch, it decided to go ahead. NASA never even informed the seven shuttle astronauts of the engineers' concerns.

On June 6, 1986 the presidential commission on the Challenger disaster issued its report. It enumerated a series of safety shortcomings in the shuttle program. In its findings it stated "neither Thiokol nor NASA responded adequately to internal warnings about the faulty seal design." It continued "NASA and Thiokol accepted escalating risk apparently because they "got away with it last time." As Commissioner Feynman observed, the decision making was: "a kind of Russian roulette. ... (The Shuttle) flies (with O-ring erosion) and nothing happens. Then it is suggested, therefore, that the risk is no longer so high for the next flights. We can lower our standards a little bit because we got away with it last time. ... You got away with it, but it shouldn't be done over and over again like that." (1)

It concluded that evidence of O-ring erosion prior to the Challenger flight was significantly severe as to have warranted corrective action. It noted that an analysis of previous O-ring erosion would have established a correlation between O-ring damage and cold temperatures.

The commission recommended changes in the technical and management problems exposed in the disaster, including the routine issuance of flight "waivers." It also called for a complete redesign of the O-rings

The report, however, absolved the Reagan administration and top NASA officials of blame, claiming they were never informed of the concerns of engineers about the safety of the launch. Instead, the commission singled out for blame several mid-level NASA officials at the Marshall Space Flight Center.

Rogers pressured committee members, in particular Feynman, to tone down the language of the report. Feynman had written a scathing assessment of NASA management's procedure for risk evaluation. He ridiculed NASA's claim that the probability of shuttle failure was 1-in-100,000, saying this number was chosen arbitrarily to make the program look safe, when the real probability of failure was 1-in-50 or 1-in-100.

He wrote: "Finally, if we are to replace standard numerical probability usage with engineering judgment, why do we find such an enormous disparity between the management estimate and the judgment of engineers? It would appear that, for whatever purpose, be it for internal or external consumption, the management of NASA exaggerates the reliability of its product, to the point of fantasy." (2)

Many members of the commission were dissatisfied with the report. It was clear that even if top NASA officials had not been directly told of the problems, they had made it abundantly clear to subordinates that they did not want to hear anything that would stop the launch.

When Senator Ernest Hollings asked commission members why they had not questioned the White House about rumors that Reagan officials intervened to demand no further delays, Rogers erupted. "The president said himself nothing like that happened. There's no evidence in this case. There isn't one scintilla!" he shouted.

The destruction of the space shuttle Columbia expresses at a higher stage the same pressures and contradictions that led to the Challenger explosion. The space shuttle was originally designed in the early 1970s, based on a compromise design aimed at cutting costs. NASA has never been given the funds to upgrade its space vehicles to 21st century technological standards. The aging fleet of shuttle vehicles has been a

disaster waiting to happen for years.

Scientific investigation and the safety of the astronauts themselves has taken a back seat to commercial interests and military needs. The inquiry into the Columbia disaster promises to be even more perfunctory than the Challenger commission. Even before the definite cause of the accident has been established, calls are being raised for an early resumption of shuttle launches.

The genuine scientific and technological promise of the space program cannot be realized under conditions of its subordination to the interests of the US financial elite, which sees the space program primarily as a source of national aggrandizement, enhanced military power and potential corporate profit.

As in every other sphere of economic, social and intellectual life, the progressive development of space exploration is not compatible with an economic system whose motive force is private profit, not the needs of society as a whole.

**Notes:**

1. The Presidential Commission on the Space Shuttle Challenger Accident Report, June 6, 1986 chapter 6
2. Ibid. Appendix F, Personal observations on the reliability of the Shuttle



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