

COVER STORY

Debate raged night before doomed launch

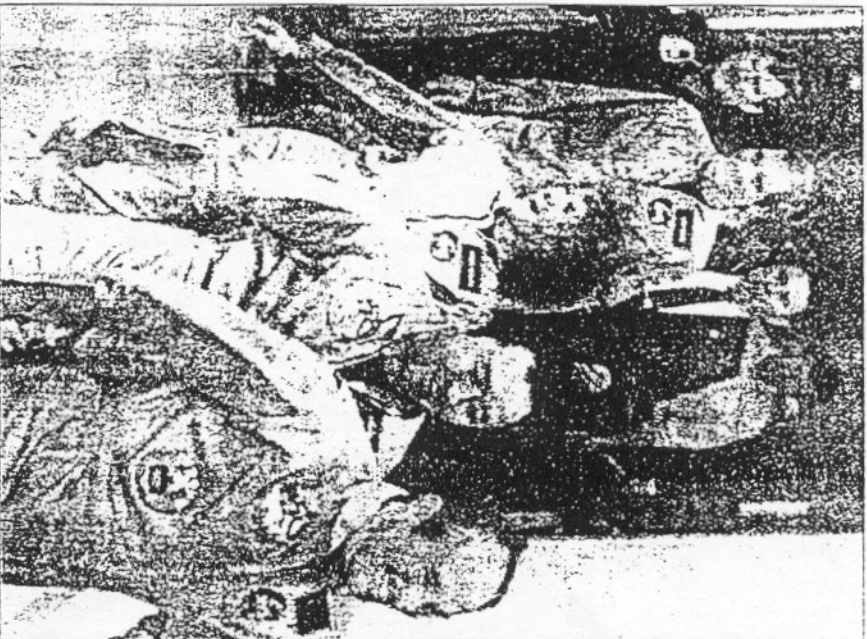
By Paul Hoyersten,
Patricia Edmonds
and Haya El Nasser
USA TODAY

'There were
the two of us
that didn't
want to fly
and we were
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maker Morton Thiokol knew someone had to be wrong.

Shortly after launch on Jan. 28, 1986, Challenger was engulfed in a fiery explosion that led to the deaths of six astronauts and teacher-in-space Christa McAuliffe. As a shocked world watched great billows of smoke trail over the Atlantic, it was clear to those involved that launching Challenger in 36-degree weather was a catastrophic decision.

This is the story of the architects of that decision. It is a



AP file photo

Among crew: En route to Challenger. From left, Mike Smith, Christa McAuliffe, Ellison S. Onizuka and Greg Jarvis.

Manager: 'Odds will sooner or later get us'

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story of ruined careers and haunted lives. It also is the story of resilience in the face of monumental failure. Above all, it is the story of how, while the USA moved on from the disaster, some men's lives were changed forever.

Some left aerospace engineering for good. Some turned inward, consumed with regret at not having done more to stop the launch. Others sought redemption through work as they raced to redesign the shuttle's faulty booster rockets with almost penitential diligence.

By the time shuttle *Discovery* launched more than 2½ years later, some felt restored. But others still cringe, or pray, each time they watch a shuttle shooting skyward.

Critics say Thiokol bowed to pressure

It all started with a phone call from Larry Wear, a NASA booster rocket manager. He was at Cape Canaveral, Fla., on Jan. 27, 1986, when *Challenger's* launch was scrubbed because of high winds, and reset for the next day. But now he was calling Thiokol engineers with a different concern: the cold weather predicted for launch the next day.

Shuttles had gone off in weather as cold as the low 30s, but with telltale leaks in the booster joints to show for it. Stirred by Wear's inquiry, Thiokol engineers began arguing that the boosters need not go in temperatures below 53 degrees. Weather forecasts for the Cape predicted overnight temperatures in the 20s.

Wear's question led to a series of meetings through the afternoon and into the evening. They culminated in an agonizing, late-night conference call that some remember as the most contentious engineering debate they had ever heard.

"It was the trigger that did it, so be it, but I would have thought there were half a dozen other people who'd be asking the same question," says Wear, 61, now retired in Huntsville, Ala.

In the end, however, critics say Morton Thiokol bowed to pressure from NASA, giving a thumbs up to the launch over the objections of engineers.

Two who argued the longest and loudest against launch were Thiokol engineers Roger Boisjoly and Arnie Thompson. But their lives took widely differing paths after the accident.

Boisjoly remembers the pre-launch debate this way: "When NASA created the pressure, they all buckled."

He became nationally known as the primary whistleblower. Thiokol removed Boisjoly from the investigation team and sent him home after he testified before a presidential commission that the company ignored evidence that the booster rocket seals would fail in cold weather.

Boisjoly, 57, says he was blackballed by the industry and run out of town by Thiokol.

For a time, he sought psychiatric help. "It just became unbearable to function," says Boisjoly, who now lives with his wife and daughter in a small mountain town in Utah. He spoke on condition that the town not be named because he fears for his family's safety.

Boisjoly is convinced he is a marked man because some former co-workers believe his testimony contributed to resulting layoffs at Thiokol.

After the accident, he says, drivers would try to run him off the road when he was out on a walk. He got threatening phone calls. Someone tried to break into his house.

"It became so uncomfortable for me that I went out and bought a .38 revolver," he says.



Boisjoly: Thiokol engineer objected to *Challenger* launch.

Now retired, Boisjoly earns \$1,500 for speeches to universities and business groups. He also runs his own engineering company and teaches Sunday school in the Mormon church, something he says he never would have dreamed of doing before the accident.

Says Thompson, the other voice against launch: "There were the two of us that didn't want to fly and we were defeated. A lot of my top managers were not happy with me."

Yet, with longer ties to Thiokol than Boisjoly, Thompson was promoted to manager and stayed on through the shuttle's redesign.

He retired three years ago at the end of a 25-year career. Now 66, he spends his time building a small office building in Brigham City, Utah.

"My attitude was, I wanted to stay on and redesign the bird and get back into the air," says Thompson. "I had a personal goal to get flying again."

NASA's Frank Adams felt the same way. As the Marshall Space Flight Center's deputy manager for boosters, he helped organize a post-mortem that went over every inch of *Challenger* equipment and every aspect of its design.

But soon after shuttle flights resumed in 1988, Adams moved onto unmanned missions, passing up a promotion.

"I just didn't think I could face the potential risk any more of going through something like *Challenger*," says Adams, now 59 and retired. "And that risk is there. ... The odds will sooner or later get us."

Thiokol's Bob Ebeling was so sure that *Challenger* was doomed, he asked his daughter, Leslie, then 33, to his office to watch "a super colossal disaster" unfold on live TV.

When it exploded, "I was in the middle of a prayer for the Lord to do his will and let all these things come to a happy ending and not let this happen," says Ebeling, who managed the rocket ignition system for Thiokol. "We did our level best but it wasn't good enough."

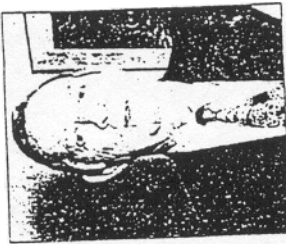
The fact that he foresaw disaster and could not stop it has tormented him since.

Ebeling, 69, says that within a week of the accident he became impatient and suffered high stress and constant headaches, problems he still has today. After 40 years of engineering experience, Thiokol "put me out to pasture on a medical" retirement, he says.

Ebeling still feels "the decision to recommend a launch was pre-ordained by others, by NASA leaning on our upper management. The deck was stacked."

One of those who overruled Ebeling and the others was Jerry Mason, the senior Thiokol manager on the conference call. He took an early retirement from Thiokol five months after the disaster, ending a 25-year career in aerospace.

"I was basically responsible for the operation the day it happened," says Mason, 69. "It was important to the company to put that behind them and get going on the recovery and it would be hard in do that with



Adams: Booster manager says the risk is still there.

lenger explosion placed much of the blame on NASA's George Hardy, a senior engineering manager.

By saying he was "appalled" by Thiokol's fears of flying in cold weather, critics charged, Hardy pressured Thiokol into approving the launch.

But Hardy refuses to shoulder the blame. If Thiokol had stuck to their position, there wasn't any way we were going to launch," he says.

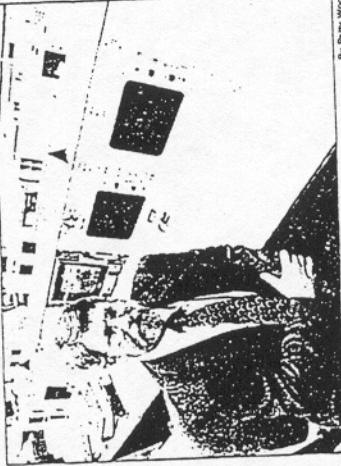
Hardy left NASA four months after the accident. Now 65, he runs a small aerospace consulting company in Athens, Ala.

Whatever else the last decade brought, many of the recollections return to that pressure-packed conference call on the eve of launch.

On every flight, says Wear, "there was a risk to the crew. ... None of them were without risk." But Wear was so confident of *Challenger's* success that he kept a doctor's appointment just before launch.

He watched liftoff in a department store TV showroom. "I didn't have any idea what it was that caused it at that point," he says now. "But I knew it was over

Stunned commentator told the world



Voice of tragedy: Stephen Nesbitt, *Challenger* mission commentator, at the unused control room at Johnson Space Center.

2½ years later on the first post-*Challenger* flight.

"For me, it was a feeling of having completed the circle," says Nesbitt, who no longer calls launches.

Here's how Nesbitt called the *Challenger* launch:

15 seconds — "*Challenger* now heading down range."

28 seconds — "Engines beginning throttling down now at 94% ... We'll throttle down to 65% shortly."

44 seconds — "Engines at 65%. Three engines running normally. Three good fuel cells ... Velocity 2,257 feet per second (1,400 mph)."

1:04 — "Engines throttling up, three engines now 104%."

1:06 — Dick Covey, capsule communicator at mission control: "*Challenger*, go at throttle up."

1:12 — Dick Scobee, *Challenger* commander: "Roger, go at throttle up."

"I think (*Challenger*) had an effect on my personal life," says Lovinggood, "a long-term effect."

After the accident, he went to work for Thiokol in Huntsville and retired as director of engineering in 1993. Now married, he spends his time puttering in the yard of his home in Gurney, Ala., home.

"Sometimes when I think about the seven people (onboard the shuttle) it's pretty painful," says Lovinggood.

Besides McAuliffe, on board *Challenger* were commander Dick Scobee, pilot Mike Smith, and astronaut Ronald McNair.

Ellison Onizuka, Judy Resnik and Greg Jarvis.

Their families settled with him after his marriage.

Investigations of the *Challenger* mission

of engineering for the redesign. Both NASA and Thiokol pumped millions into the project as they scrambled to get the nation's space program back on track.

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Investigations of the *Challenger* mission

Engineers waver, then decide to launch



Lovingood: Urged going along with rocket maker's recommendations

The debate over whether to launch on Jan. 28, 1986, unfolded as follows, according to the report of the Presidential Commission on the Space Shuttle Challenger Accident.

Shortly after 1 p.m. ET on Jan. 27, NASA's booster rocket manager in Cape Canaveral, Larry Wear, asks officials of rocket maker Morton Thiokol in Utah whether cold weather on the 28th would present a problem for launch.

By 2 p.m., NASA's top managers are discussing how temperatures in the 30s at the launch pad might affect the shuttle's performance. In Utah, an hour later, Thiokol engineer Roger Boisjoly learns of the forecast for the first time.

By late afternoon, midlevel NASA managers at the Cape are on the phone with Thiokol managers, who point out that the booster's rubbery O-rings, which seal in hot gases, might be affected by cold.

That concern brings in officials from NASA's Marshall Space Flight Center in Huntsville, Ala., which buys the rockets from Thiokol and readies them for launch.

Marshall managers decide that a three-way telephone conference call is needed, linking NASA and Thiokol engineers and managers in Alabama, Florida and Utah.

The first conference call begins about 5:45 p.m., and Thiokol tells NASA it believes launch should be

delayed until noon or afternoon, when the weather turns warmer. It is decided a second conference call would be needed later that evening.

Marshall deputy project manager Judson Lovingood tells shuttle projects manager Stan Reinartz at the Cape that if Thiokol persists, NASA should not launch. Top NASA managers at Marshall are told of Thiokol's concern.

At 8:45 p.m., the second conference call begins, involving 34 engineers and managers from NASA and Thiokol at the three sites.

Thiokol engineers Boisjoly and Arnie Thompson present charts showing a history of leaking O-ring joints from tests and previous flights.

The data show that the O-rings perform worse at lower temperatures and that the worst leak of hot gases came in January 1985, when a shuttle launched with the temperature at 53 degrees. Thiokol managers recommend not flying Challenger at temperatures colder than that.

NASA's George Hardy says he's "appalled" at Thiokol's recommendation. Larry Mulloy, Marshall's booster rocket manager, complains that Thiokol is setting down new launch criteria and exclaims, "My God, Thiokol, when do you want me to launch, next April?"

Thiokol Vice President Joe Kilminster asks for five minutes to talk in private. The debate continues for

30 minutes. Boisjoly, Thompson, engineer Bob Ebeling and others are overruled by Thiokol management, who decide to approve the launch.

At 11 p.m., Kilminster tells NASA that Thiokol has changed its mind: Temperature is still a concern but the data is inconclusive. He recommends launch.

Thiokol's concerns that cold weather could hurt the booster joints are not passed up NASA's chain of command beyond officials at the Marshall Space Flight Center.

Challenger is launched at 11:38 a.m. Jan. 28 in a temperature of 36 degrees.

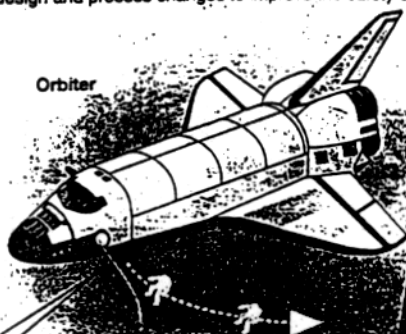
By Paul Hoyersten

Improving the space shuttle's safety

The Challenger disaster a decade ago prompted myriad technical and procedural changes before another space shuttle was launched. NASA, working with its own experts and the advice of a presidential commission, made nearly 600 design and process changes to improve the safety of the

program before shuttle Discovery was launched in 1988. Much of the redesign work focused on crew safety during emergencies and on improving the solid-fuel booster rocket, where a joint gasket called an O-ring failed, causing gases to escape and triggering the Challenger explosion.

An important safety improvement since the Challenger explosion is a new crew-escape system for use after launch. It can only be used once boosters separate 2 minutes into a flight and the external fuel tank is jettisoned. Even if the crew had survived the Challenger explosion, they had no safe method of escape.



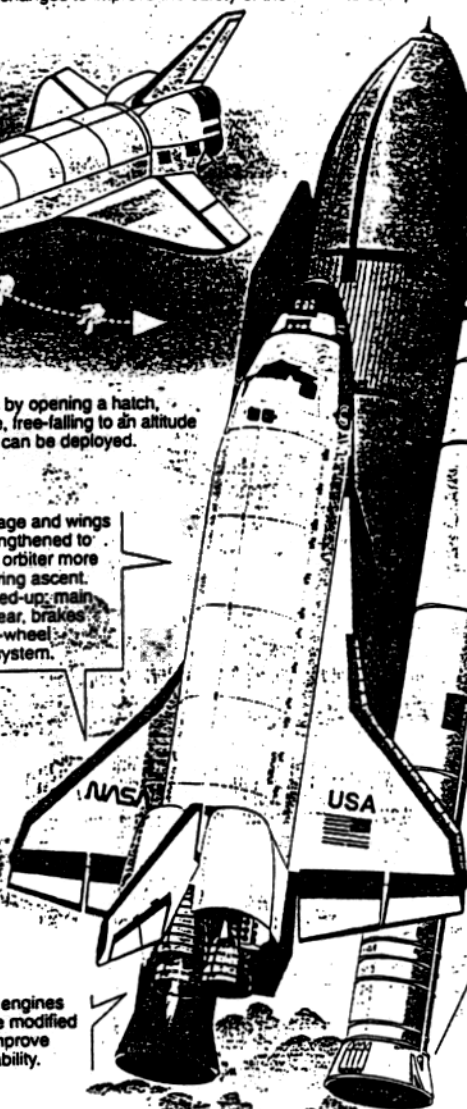
The crew escapes by opening a hatch, sliding down a pole, free-falling to an altitude where parachutes can be deployed.

The fuselage and wings were strengthened to make the orbiter more stable during ascent. Also beefed-up: main landing gear, brakes and nose-wheel steering system.



A 17-inch safety latch was placed on fuel valves between the orbiter and the external fuel tank to avoid propellant loss when the orbiter separates from the tank just before reaching orbit.

The engines were modified to improve durability.



Solid-fuel booster

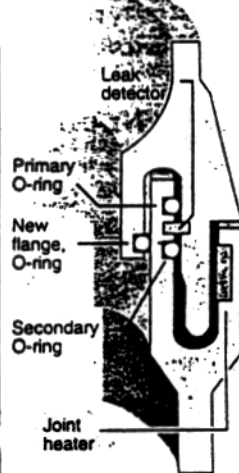
Solid-fuel booster

The solid-fuel booster joints (blamed in the Challenger explosion) were extensively redesigned and additional O-rings were added. The new design provides stronger, tighter seals.

Old joint



New joint



New heaters were built into joints to keep the O-rings and other seals warm. Thermostats keep the seals between 80° and 123° before launch. NASA considers 93° the ideal temperature for maximum efficiency of the seals.

New launch rules

- Fueling of the external tank is not permitted if the average temperature is below 41° during the 24 hours before a launch.
- No launch is allowed if the outside temperature is below 37° with winds at or above 5.75 mph, or below 47° with winds below 5.75 mph. Challenger was launched when the outside temperature was 36°, 15 degrees below that of any previous shuttle launch.

In a tourist age, NASA debates its future

By Marcia Dunn

Associated Press

CAPE CANAVERAL, Fla. | When a Russian spaceship flew to the international space station last spring, a millionaire tourist wasn't the only commercial payload.

The Russians — ever on the lookout for a quick buck — also delivered a crispy-crust salami pizza on behalf of Pizza Hut. And a pair of talking picture frames personally dedicated to the two dads on board, courtesy of RadioShack. And a March 2001 issue of *Popular Mechanics*, compliments of the magazine.

Now, NASA is about to jump on the space-for-sale bandwagon.

A draft document issued by NASA is circulating among space-exploration advocacy groups and industry insiders. Titled *Enhanced Strategy for the Development of Space Commerce*, the report proposes what would have been anathema to many within the agency before California businessman Dennis Tito became the world's first paying space tourist, thanks to the Russians.

Among the ideas put forth in the document, which NASA says is a work-in-progress:

Allow limited tourism on the space station, but with transpor-

tation from the Russians or future commercial spaceships (probably not the U.S. shuttle); seek family-friendly corporate sponsors that could plaster their emblems and logos alongside NASA's; and permit merchandising that promotes the so-called NASA brand.

The plan also proposes stronger ties with the entertainment industry to boost the space program; creation of a logo for the international space station similar to the approach of the International Olympic Committee; and hiring of a nongovernment organization to manage the U.S. side of the space station.

All this from a space agency that forbade its astronauts from hugging Mr. Tito on camera during his weeklong visit to the international space station, and which for years balked at even giving a name to the orbital complex.

But NASA still talks tough when it comes to space tourists flying on the shuttle, much to the chagrin of advocates who want space frontiers opened to everyone.

"They've totally blown the management of the international space station, and so they're kind of like looking for what I call mil-

lion-dollar solutions to billion-dollar problems," said Rick Tumlinson, president of the Space

Frontier Foundation, which believes the settlement of space is human destiny.