



## NASA-5 Mike Foale: Collision and Recovery

May 15 - October 6, 1997

| [Collision and Recovery](#) | [Foale Bio](#) | [Needed on Mir](#) | [Meanwhile](#) |

### Collision and Recovery



Mike Foale went to Mir full of enthusiasm in spite of the fire and other problems during the NASA-4 increment. He expected hard work, some discomfort, and many challenges; and he hoped to integrate himself fully into the Mir-23 crew.

The challenges became enormous when a Progress resupply vehicle accidentally rammed the space station, breaching the Spektr module and causing a dangerous depressurization. The Mir-23 crew worked quickly to save the station; and in the troubled months that followed, Foale set an example of how to face the more dangerous possibilities of spaceflight.

Meanwhile on the ground, NASA's Mir operations were changing, too. In part because of the problems, Foale's NASA-5 increment catalyzed a broader and deeper partnership with the Russian Space Agency.

Mike Foale's diverse cultural, educational, and family background helped him adapt to his life onboard Mir. Born in England in 1957 to a Royal Air Force pilot father and an American mother, his early childhood included living overseas on Royal Air Force bases. An English boarding school education taught him how to get along with strangers; and, as a youth, he wrote his own plan for the future of spaceflight. At Cambridge University, Foale earned a Bachelor of Arts in physics and a doctorate in astrophysics. But, in the midst of this progress, disaster struck. Foale was driving through Yugoslavia with his fiancée and brother when an auto accident took their lives but spared his own. This experience undoubtedly taught Foale about life's fragility and risks. Nevertheless, he continued an active and adventurous path, including diving to salvage antiquities in the Aegean Sea and the English Channel.

After university, Foale moved to America to pursue a career in

Welcome

Book Text

Features

CD  
Supplements

Photos

Videos

Diagrams

Search

[Back to  
NASA-5  
TOC](#)

the United States space program. He was working as a Space Shuttle payload officer in 1988 when he was selected for astronaut training. He flew on STS-45 and STS-56, and then became involved with the Shuttle-Mir Program as a crewmember of the "near Mir" STS-63 mission in 1994. In October 1995, while in Star City working on spacewalk issues, Foale found himself unexpectedly tapped for the NASA-5 mission. The reason? Two previously scheduled astronauts—Scott Parazynski and Wendy Lawrence—did not fit new size restrictions for the Soyuz escape capsule's seats. For a while, a modified "Three Bears" folktale circulated at NASA: "Scott is too tall; Wendy is too short; but Mike is just right." Within weeks, Foale moved to Star City with his wife, Rhonda, and their family so he could train for his mission on Mir.

Like NASA-2 Mir Astronaut Shannon Lucid, Foale saw his training in science and his self-identity as a scientist as helpful preparation to becoming a long-duration astronaut. He also valued "the willingness to undergo something very different and foreign." He has said, "It was that trepidation—but interest nonetheless—to get through it. To go and do this strange thing. I think it comes out of a person, based on his background, culture, and family. I'm not sure it's something we could train into a person."

When Foale launched to Mir onboard *Atlantis* (STS-84) on May 15, 1997, the Shuttle-Mir Program was maturing. This mission marked docking number six, and Foale and three of his crewmates had prior experience flying a Space Shuttle to Mir. Commander Charlie Precourt had been the pilot of STS-71. Pilot Eileen Collins had been Foale's crewmate on STS-63. Cosmonaut Elena Kondakova had experienced 169 days in space as a Mir-17 crewmember in 1994-95, including six days with NASA-1 Mir Astronaut Norm Thagard. The Mir complex had grown since any of them had seen it last. The Russian space station now included the new Priroda science module plus the new Russian-built and U.S.-delivered docking module.



Foale has described his first view of Mir, back in 1995 with STS-63, as "like seeing the great wall of China from a distance. You don't relate to it. You know you don't have to live in there." For the STS-63 crew, it was somewhat like being a tourist on a bus tour. They could see Elena Kondakova, Aleksandr Viktorenko, and Valeri Polyakov waving, all excited. "We didn't understand each other very well," Foale said, "but we had Vladimir Titov onboard, who could speak with them. We lingered there.... They invited us to tea." Of course, the first Shuttle-Mir docking and a real tea with the Russians wouldn't take place for four more months, during STS-71.

On STS-84 when Foale saw Mir for the second time, the space station—besides being bigger—looked in better condition than he had imagined. "I was expecting worse and saw something

better," he said later. "I saw brighter, more cheerful objects." Mir was different than the "dull, cellar-like impression I'd had in my mind." When Foale floated into the Mir living area, the atmosphere he found there cheered him. "It was a warm, welcoming, cozy place" in spite of the masses of cables and equipment and wires. Happily for Foale, "It looked like a home."

NASA-4 Mir Astronaut Jerry Linenger greeted Foale and provided him an accurate, personal picture of what to expect. He said it was not accidental that the Mir looked and even smelled better than the astronauts had expected. "Every free moment during the weeks prior to the arrival of the Shuttle was spent cleaning up," he added. Linenger personally showed Foale "how he would don the respirator, find his way into the Soyuz capsule, and activate the fire extinguisher."



According to Foale, "Jerry and I talked for a long time, maybe a total of six hours or so over three or four days.... Jerry was being very careful to tell me, 'Don't be fooled by the illusion that this is all okay while the Shuttle's here. It will change.'"



Also greeting Foale were his new Russian crewmates, Commander and Mir veteran Vasily Tsibliev and first-timer

Flight Engineer Aleksandr (Sasha) Lazutkin. The schedule called for Foale to help the two cosmonauts finish their Mir-23 mission, and then to serve on the first part of the Mir-24 expedition. "I certainly enjoy their company," Foale said of his new crewmates from orbit. "We spend every meal ... chatting and talking."

Right away, Foale acted to ensure that he fit in with the crew. First, he noticed that the crew spent a lot of time dealing with e-mails and instructions from the ground, so he wrote a computer program to automate that effort, thus saving them an hour of work a day. Second, he made sure he was present for every communications session, and he spent time with Tsibliev and Lazutkin. Foale said that it was easy to lose oneself in one's work onboard Mir, and—oddly—to lose track of the others. "It's not because the Mir is such a big space. It's because it's such a cluttered space. You could easily spend a day without talking to crewmembers." Foale's easy familiarity with his crew, and with the Russian ground team, would serve him well later when times got tough.

Foale's crewmates opened up to him about the troubles during Linenger's increment, including the fire. "Vasily talked about it quite a bit," Foale recalled. "Sasha [Lazutkin] ... took me to where the fire occurred and showed me what he was doing and how the fire happened. He gave me a long hour's description of everything that happened during the fire. It was very amusing. It

was a good story with serious undertones. But, he wasn't making a big deal out of this. He was telling me a story because I wanted to learn. And, other times, Vasily would talk about the near-miss of the Progress docking. That was a very close call."

Foale settled into his work on Mir. He later said, "My whole frame of mind was, 'This is not a Shuttle flight. This is long-duration. So, in the first two or three weeks, if I don't get all these things done, it's not a problem.'" He would give it what he called a "best-faith attempt ... working seriously to do what I could" while building a good relationship with his Russian crewmates. "Sometimes in the afternoon Sasha Lazutkin would find me and say, 'Mike, you want to drink tea?' And, we'd drink tea. Then we'd go back to doing whatever we were doing. That was kind of the existence I had up to the collision."

To create his own living space, Foale tied his sleeping bag in a corner of the Spektr module, which was new but not all that comfortable. Spektr's sidewalls were skewed a disorienting 45 degrees off those of the Base Block and were crowded and noisy. "I feel like I'm living in a garage," Foale reported from orbit. Behind Spektr's panels, two drive motors slowly rotated outside solar arrays. Foale could hear them at night while he slept.

Foale got right to work on his science, setting up special containment areas where 64 black-bodied beetles would be exposed to special lighting conditions in a study of the insects' circadian rhythms. He prepared the Svet greenhouse facility for an experiment on rapeseed growth in microgravity. In addition to other investigations, he also assisted his crewmates in the continuing search for leaks in a Kvant-1 cooling loop.

Foale enjoyed working with the Mir crew "just on general maintenance tasks, where you are helping each other, just fixing tubes and using a wrench. None of it's very hard mentally, but you're working together. You're with people, and communicating and joking, and I like doing that stuff."



All in all, life onboard Mir was going very well. In terms of environmental systems, June was the quietest month in a long time. Foale said that, "compared to being on Shuttle, I feel much more healthy. I've noticed that my vision, for example, is really clear. It may be because I've managed to avoid all that paperwork I had to do on the ground in Houston. With the three or four hours of exercise that we do each day ... and along with the regular diet and all the rest, I feel very healthy. And, of course we don't get colds here. No one comes by to infect us. It's a very pleasant place. It doesn't rain!"

Figuratively, however, a storm of troubles was approaching. As June passed, the crew



got ready for the arrival of a Progress resupply ship that would deliver more food and supplies. But, before its arrival, Moscow ground controllers had instructed Commander Tsibliev to test the new tele-operated remote unit docking system by remotely controlling the redocking of the previous Progress, which recently had been undocked from Mir. In addition to expanding operational capabilities, the remote unit docking system was intended to reduce the launch weight on Progress vehicles and to eliminate the expense of the automatic Kurs equipment, which now had to be purchased from the Ukraine.

Commander Tsibliev had good reason to be concerned about the procedure. In January 1994, during a Soyuz redock, the vehicle gently bumped into Mir. During Jerry Linenger's residency, Tsibliev had attempted another remote docking; but he had lost control of the spacecraft and had narrowly missed ramming the space station.

After that incident, Moscow ground controllers reasoned that perhaps a radar system had caused interference. For this next attempt, they would have the radar turned off. Mike Foale and Aleksandr Lazutkin would provide the only direct measurement of the approach. They would watch for the Progress from Mir's windows, ready to use handheld lasers to help gauge the vehicle's distance and closing speed.

On June 25, 1997, Tsibliev took remote control of the Progress and fired its rockets to propel the craft toward the space station. In ways, the procedure was similar to playing a video arcade game. Tsibliev had to virtually "fly" the Progress from onboard Mir while he watched a video screen that showed an image from a camera onboard the Progress.

The Progress left its parking orbit and began moving rapidly toward Mir. But, on the video screen "it was difficult to make out the station," according to Tsibliev. The Mir complex "looked very similar to the clouds below it." Tsibliev's deficient perspective had a further limitation. According to Foale, "What Vasily was seeing on his screen was an image that didn't change in size very fast. That's the nature of using a TV screen to judge your speed and your distance. He couldn't determine accurately from the image that the speed was too high." By the time Tsibliev could judge the speed, the Progress was already traveling too fast. He fired the braking rockets, but it was too late.

Aleksandr Lazutkin finally espied the Progress, and he realized the danger. "Michael, get in the escape ship!" he told Foale. Lazutkin later described the onrushing Progress as looking "full of menace, like a shark." He said, "I watched this black body covered in spots sliding past below me. I looked closer, and at

that point there was a great thump and the whole station shook."

The Progress collided with a solar array on the Spektr module. Then, the spacecraft hit Spektr itself, punched a hole in a solar panel, buckled a radiator, and breached the integrity of Spektr's hull.

Foale had moved into the node at this point. He felt the impact shudder through his fingertips. He heard what seemed to be "a far-off ker-thump." Then the crew heard hissing and their ears began popping. According to Tsibliev, "The decompression alarm system immediately went off. The pressure began to fall, and the station started to spin." Precious air went rushing out into the vacuum of space.

The crewmembers all realized the mortal severity of the situation. They might have to get into the Soyuz capsule and abandon the space station. Tsibliev checked a pressure meter inside the Base Block. The needle was moving down toward 600 millibars of pressure; 540 millibars was necessary for the crew to maintain consciousness.

While not knowing at the time exactly where the punctures were or even how many there might be, Lazutkin and Foale first worked in the node to seal off the Spektr from the rest of the station. In their way lay masses of tubes and cables that had been routed through the hatch and into the node since the day Spektr had been docked to the station. They worked as fast as they could. "We started pulling the cables," Foale related later. "There was a cable that burned in spots, so we had to find a way of disconnecting that one."



Once they had cleared the hatch, they needed to seal it with a cover. The node had six hatches, but all the covers had been tied out of the way. First, Foale and Lazutkin tried to free a big hatch cover that had a valve they could use later to equalize air pressures. Stubbornly, however, this one proved too difficult to untie. According to Foale, they "wasted about a minute" trying to untie that hatch. "And, the pressure's falling. The pressure's falling." Foale began thinking, "Things are getting pretty tense now."

The two crewmates had to give up on the big hatch. They found a thinner hatch cover. They untied it, and that one "popped" into place. The air pressure in the node forcefully pushed the hatch against the hatchway. "Truly," Foale thought, "there is a leak on the other side of this."

As his ears stopped popping, Foale knew they had isolated the leak and the immediate crisis had passed. As he expressed later, at this point he had thought, "Hmm. I guess I'm not going home." Then, he realized, "Well, okay. We're here for the long haul." Then, ever the optimist, he looked on the bright side.

"Well, hey! We just survived a pretty big emergency!"

But, a longer-term, chronic crisis had been created. Some of the cables Foale and Lazutkin had disconnected had served to provide electrical power from the Spektr's solar arrays to the rest of the station. Their disconnection, along with the station's tumbling, now caused a power loss on Mir and the shutdown of the central computer. The station fell dark and silent.



This was a novel experience for Foale, who had by this time grown used to the ever-noisy Mir. He said later, "For the first time I experienced a totally silent, still space station. There are no fans moving. There is no light on. Nothing is alive. Just our breathing is causing any sound." Aleksandr Lazutkin was more dramatic in his description: "The silence is deafening. You want to close your ears so you can't actually hear the sound of silence. It's painful. You experience flight in a completely different way." According to Vasily Tsibliev, for a time after the accident, "We watched the polar lights and the stars in complete silence."



The power outage lasted about a day-and-a-half. Because of the orientation of Mir's orbit at that time, the station was more often in Earth's shadow than in the Sun's light. Only when a panel happened to catch some solar energy did they have enough power to contact ground controllers in Moscow.

According to Foale, this was the hardest time he experienced onboard Mir; but that hardship was mainly because they all got so fatigued. Lazutkin went two full days without sleep.



On the other hand, this was also a time of opportunity for Foale. The Russian controllers were now ready to let Foale take a major role in the recovery of their space station. Since his arrival, Foale had been serious about talking with the ground team and had eagerly volunteered for other station work, such as sopping up condensate from the station's walls.



The collision had knocked Mir into a spin; and the power outage had shut down the gyroscopes so that the spin now went uncontrolled. To stop the spin and face the arrays toward the Sun, the crew needed to know the spin rate of Mir. However, the computer and other instruments were out of operation. So, in the dark and in the silence, Foale went to the windows in the airlock and held his thumb up to the field of stars. Combining a sailor's technique with a scientist's knowledge of physics, Foale estimated the spin rate of the space station. Then, he and Lazutkin radioed the

estimates down to the Moscow Control Center. The ground controllers fired Mir's engines, and that stopped the spin—certainly not perfectly, and in no way permanently; but it showed that it could be done.



For future corrections, the crew would sometimes use the rocket engines on the Soyuz capsule. However, these engines pointed at a 45-degree angle to the axis of the main station. This and other factors created another problem in physics, as well as in onboard communications. Foale found an older, 18-inch scale model of Mir to which flashlights had been taped to approximate the newer Spektr and Priroda modules. In the microgravity of Mir, Foale set the Mir model to slowly spinning. Then he shined another flashlight onto the model, thus simulating the Sun. In this way, he determined how Tsibliev—who sat at the Soyuz capsule controls—should apply pulses with the Soyuz jets to set up a stable rotation and orient the solar arrays to the Sun. Over the next hours, Foale kept a star watch at his window and shouted instructions to Tsibliev in the Soyuz, many feet away.

Finally, the crew took turns catching a few hours of sleep. Then, they got back to their hard work in the dark. According to Foale, "We basically hunkered down and had to deal with a station that had all power removed from all modules except for the front two." The crew started moving batteries from the darkened modules to the Base Block to charge them up. They kept a supply of charged-up batteries ready to power the Base Block if the power went out again. This chore and other work occupied them for the week after the collision.

The now-out-of-reach Spektr had been Foale's bedroom. All of his private articles and many of his experiments were sealed behind the hatch in the vacuum of space. Tsibliev searched the Russian supplies and found a toothbrush for the American. Foale worked with NASA officials on the ground, who put together a care package to be sent up on the next Progress ship, which arrived automatically on July 7.

Also onboard the Progress was the hermaplate, a modified node hatch cover that had been hurriedly built to allow the reattachment of Spektr's cables. To try and effect these reattachments, Tsibliev and Lazutkin were scheduled to don spacewalking suits and perform what amounted to an internal spacewalk into the vacuum of Spektr.

As the crisis continued, Foale actually learned to enjoy rotating the station, in spite of the fact that this was a tricky procedure. Tsibliev was understandably worried about wasting fuel that might be needed for a trip home; but, on Foale's instructions, he pulsed the Soyuz jets to cause complicated movements "up and to the right, or down and to the left." Lazutkin came up with an ingenious way to use a normally Earth-observing periscope to

track the Sun and thus trace the station's motion.

Another painful twist of fate occurred on July 13. While Tsibliev exercised on the stationary bicycle, he recorded an irregular heartbeat. Medically, this disqualified him from conducting the internal spacewalk.

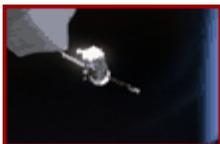
NASA and Russian officials agreed that Foale could participate in the spacewalk instead of Tsibliev, and Foale started training. He was already one of NASA's extravehicular activity experts, and the Russians now trusted his judgment and skill.

But, then an event occurred that might make anyone feel jinxed. On July 17, during one of the training exercises, Lazutkin mistakenly disconnected an important power cable. The cable was one of hundreds, and the action was an easy mistake for a fatigued crewman; but it caused another severe power outage and a computer collapse. "Oh, my feelings!" Lazutkin said later. "Shooting yourself would be easier! It was terrible. The station emergency alarm went off. I realized instantly that I'd made a mistake."

The station fell into another period of tumbling without power, in which it was discovered that the Soyuz escape capsule's power could not be switched on unless the main station's power was also working. This fact had serious implications for the availability of the Soyuz during a crisis. Because of this and all the problems of the Mir-23 crew, Moscow ground controllers delayed the internal spacewalk in the Spektr module until the Mir-24 crew arrived in early August.

Mike Foale worked to salvage all he could of his mission. Needless to say, the Progress collision dealt a great blow to his scientific investigations. He was, however, able to continue with several of the experiments. For example, the beetles had survived. The greenhouse was working. Many of the second set of broccoli plant seeds sprouted, including some seeds that were generated from the first set of plants. This was the first time that a second generation of space-borne plants had ever been grown. Foale was also able to do Earth observations with a Hasselblad camera. And, he and his crewmates prepared the space station for the next crew.

With all the power outages, a lot of condensate had built up on Mir's interior surfaces. According to Foale, "Fifty percent of my time was spent just mopping up water. It was like cave diving, going into a dark module with a full-length suit on." Foale mopped up the water, either with old underwear or used clothes, or with a device that sucked the water into an airtight bag.



The Mir-24 crew arrived in their Soyuz spacecraft on August 7, and the two crews accomplished a one-week handover. With the fire, the collision, and the other

challenges, Tsibliev and Lazutkin had weathered one of the more challenging long-duration missions in the history of spaceflight. Regardless, leaving Mir was for them a moment of great nostalgia. According to Vasily Tsibliev, "No one who has been there thinks of Mir simply as a pile of metal. It's as if it touches you inside, and you feel as though you're a part of the station." Aleksandr Lazutkin later said, "I didn't want to leave the station because I felt it was like a living creature."



Before reporting to Mir, Foale had gone through some training with the Mir-24 Commander Anatoly Solovyev and Flight Engineer Pavel Vinogradov. He was familiar and comfortable with them, which was good because Moscow ground controllers had planned a lot of work for the whole crew. The crew would start by moving the Soyuz to another docking port. Later, Solovyev and Vinogradov would perform the intravehicular activity (IVA) to attempt to restore power through the damaged Spektr. Then, in about three weeks' time, Solovyev and Foale would perform an extravehicular activity to inspect the Spektr module's hull for damage. This was good news to Foale, who now looked forward to participating in this spacewalk.

Repositioning the Soyuz included a fly-around to inspect the Spektr module. Foale got the job of taking photographs during the flight. Not only did this assignment provide him with fantastic views of the station, but the fly-around got him "out of the house"—his first time outside the Mir space station in months.

The next day, the crew docked a new Progress vehicle. The docking proceeded normally with the automated Kurs system, until the Kurs failed at about 200 feet out from Mir. Controllers told Solovyev to go ahead and use the tele-operated remote unit docking system—the same system Tsibliev had been using at the time of the collision. This time the remote docking system worked, except for a short dropout of the video image, and Solovyev docked the Progress.

When the time came for his crewmates' IVA in the Spektr module, Foale stationed himself inside the Soyuz escape module. In case problems with hatches and depressurization occurred and the entire crew had to make a quick escape, Foale would be ready to assist in an evacuation.

During the IVA as Solovyev and Vinogradov opened Spektr's hatch, there was a fairly rapid depressurization of the airlock they were in. This indicated the puncture hole in Spektr's hull was large—perhaps a half an inch. At this point, Vinogradov noted that one of his extravehicular activity (EVA) suit gloves was not sealing well, and they had to repressurize the airlock and get a new glove.

The two cosmonauts then went to work. Vinogradov floated feet first into the darkened module to begin the job of connecting the power cables to the special hatch plate. Solovyev joined Vinogradov a short time later, helping him inspect several areas behind panels for leaks. They found no obvious signs of puncture inside the module. Vinogradov described Spektr as being in generally good shape, with a few "white crystals" floating around, possibly from soap or shampoo, and a thin layer of frost on experiment counters that had been exposed to the vacuum of space for two months. They were able to reconnect power from two solar arrays and from part of a third. They also retrieved one of Foale's laptop computers and some photographs.

After the IVA, the crew prepared for the EVA to inspect Spektr. They also repaired systems and mopped up more condensate. Foale enjoyed assembling a truss structure to be used during the EVA. In another example of on-orbit problem solving, Foale and Solovyev came up with a way to get the balky structure out through the airlocks.



About three weeks into the Mir-24 mission, Foale and Solovyev performed their six-hour extravehicular activity. For most of this spacewalk, Foale was positioned at the base of the 60-foot Strela crane from which he moved Solovyev, at the other end, to the places Solovyev needed to work. Once or twice, Foale himself moved to the end of the Strela to hold Solovyev's feet while the Russian worked, digging with a raisin knife under Spektr's insulation and searching for holes. Although they observed a lot of damage to Spektr and its attachments, the two spacewalkers could find no actual hull breaches.

Solovyev rotated some solar arrays to provide more power that would help the station substantially. However, twice more during the mission, computer failures caused the loss of electrical power for about 24 hours each time.

The crew continued working on the condensation problems. They found "balls of water a cubic meter in size" in two modules, Kristall and Priroda, where temperatures had dropped into the 40s. However, at the same time, the Base Block's temperature had risen into the 90s; so the crew ducted its warmer air into the cold module. This initially caused an increase in condensation as the warm moist air hit the cold metal. But, slowly the modules began drying out. According to Foale, "We first powered up the Kristall, and it dried out fairly nicely; and then the last week before docking with STS-86, we finally dried up Priroda enough" to turn on its power. "And, that was an amazing thing for me," to see all the modules we had access to "all powered-up, finally."

Mike Foale's eventful mission to Mir was coming to an end. Before NASA-6 Mir Astronaut David Wolf arrived, Foale said in

a radio dispatch to the ground, "Over the next 10 days, of course, I am getting excited because STS-86, the Space Shuttle *Atlantis*, will be coming, I hope, to pick me up and switch me out with [Dave].

"During the next 10 days, I will be extremely busy packing up the 140 or so items that have been sent to me for return to Earth, as well as conducting the last pieces of research that we were unable to do when we had less electric power."

Foale referred to a growing controversy on the ground—over whether astronaut David Wolf should succeed him on Mir—by saying, "I'd like to summarize really why I think Dave Wolf should stay onboard space station Mir when I leave. Really, I think it comes down to the fact that, even though this flight has been one of the hardest things I have ever attempted in my life, I have to remember what John F. Kennedy said when I was about four years old. Forgive me if I get it wrong. He said, 'We do not attempt things because they are easy, but because they are hard, and in that way we achieve greatness.'

"I believe out of this cooperation of America with Russia, which is not always easy, we are achieving some extremely great things. And, for these reasons I think I've really valued my time onboard space station Mir. I will always remember the last three or four months with great, great alacrity and nostalgia, I'm sure. I really count all that we are doing together, America and Russia, to be extremely valuable to future cooperation on the Earth in the future."

- ▶ [Read more about Mike Foale and NASA-5](#)
- ▶ [Read the Congressional Mir Safety Hearing document](#)
- ▶ [Read the Administrator's Letter to Congress Concerning the Shuttle-Mir Program](#)
- ▶ [Watch the Progress Collision with Mir animation](#)

---

| [Collision and Recovery](#) | [Foale Bio](#) | [Needed on Mir](#) | [Meanwhile](#) |

## Foale Biography

Mike Foale was born in Louth, England, the son of a British father and an American mother. He holds a Bachelor of Arts in physics and National Sciences Tripos with first-class honors from Cambridge University, Queen's College. He also earned



a Ph.D. in laboratory astrophysics at Queen's College. Before his NASA career, Foale participated in scientific scuba diving expeditions to survey Greek antiquities; and he dove on the 1543 ocean galleon, the Mary Rose, as a volunteer diver, learning excavation and survey techniques in low-visibility conditions.

Pursuing a career in the U.S. space program, Foale moved to Houston to work on Space Shuttle navigation problems at McDonnell Douglas Aircraft Corporation. In June 1983, Foale joined NASA Johnson Space Center and worked as payload officer for four Shuttle missions. Foale became a NASA astronaut in 1988 and served as a mission specialist on Shuttle missions STS-45, STS-56, and STS-63 before beginning training for his mission on Mir.

In his oral history, Foale made a comment about coming home: "It's also moving back to America, you see. It's not just coming back from Mir. It's coming back from being posted overseas. My post overseas was one-and-a-half years to Russia, and then it was to a Russian environment—but in space."

As the first U.S. Mir astronaut to return to space, Foale flew as a mission specialist on STS-104, the third Hubble Space Telescope servicing mission. He continues to be involved with the space program at Johnson Space Center.

► [Read more about Mike Foale and NASA-5](#)

► [Read Mike Foale's Oral History \(PDF\)](#)

---

| [Collision and Recovery](#) | [Foale Bio](#) | [Needed on Mir](#) | [Meanwhile](#) |

## Needed on Mir

Shortly after the Progress resupply vehicle collided with Mir, Keith Zimmerman, NASA's Operations Lead in Moscow, talked to Mike Foale about his situation and his experiments onboard Mir. The following edited excerpts are from that radio discussion.

**Zimmerman:** Michael, this is Keith.

**Foale:** Okay. What do you need to know?

**Zimmerman:** First, how are you doing?

**Foale:** Great. As great as you can be without all your stuff.

**Zimmerman:** That's the next question. What personal stuff did you lose that needs to be replaced? And, what medical stuff did you lose that needs to be replaced?

**Foale:** I propose that we send up a complete Shuttle medical kit. And then, if you have room, the MSMK [Mir Shuttle medical kit]. Things like aspirin and some of the more common items out of the MSMK.

**Zimmerman:** Okay. Copy that. What about personal stuff? Hygiene kit, exercise shoes, personal items, clothes?

**Foale:** Exercise shoes for sure. I don't have those now. I also need my harness for the treadmill, and I need the expanders.

**Zimmerman:** Copy all.

**Foale:** I would really like to have a shaver. And, I'd like to have toothbrushes and toothpaste. About two or three tubes of toothpaste. That would do it.

**Zimmerman:** Copy.

**Foale:** Greenhouse is almost complete, except it hasn't got the leaf bags. The leaf bags are in Spektr. If you can get leaf bags on to the [Progress], it would be great. We've lost all of the bio stuff [life sciences investigations], the micro stuff [microbial sampling kits], the BDL [bar code data logger], the UBC [universal battery charger], and all the sleep equipment in Spektr.

**Zimmerman:** What about MIPS [Mir's computer interface to payloads system]?

**Foale:** COSS [crew onboard support system laptop] and all my hard drives are in Spektr. And, I have no printer. A printer would really help. If someone made an image of my hard drive, that would be great if they could send that up. I lost everything in terms of computer stuff.

**Zimmerman:** I guess the only other real question right now is, on Priroda, do you know what things were powered on when the power got cut, which switches may still be on, that sort of thing?

**Foale:** I turned off all PUPs [payload utility panels] and I turned off all equipment in an orderly fashion.

**Zimmerman:** Excellent.

**Foale:** The only thing that I'm worried about now is the beetles.

The beetles are living on batteries.

**Zimmerman:** Right. The batteries will last 30 days; but they won't be able to do a light pulse, which is on Tuesday, so we will try to get 1 amp by then. Where were you during the event?

**Foale:** In Base Block watching Vasily, getting ready to take laser marks with the laser range finder, when Sasha said to get into the Soyuz quickly. I was actually in the Node at impact.

**Zimmerman:** Do you have any words for [your wife]?

**Foale:** Just that things are fine. I felt the same as when I landed in the water [in an airplane without power]. It's all over now, and I'm glad we're getting it all together again.

---

| [Collision and Recovery](#) | [Foale Bio](#) | [Needed on Mir](#) | [Meanwhile](#) |

## Meanwhile on Earth

Just as the collision changed everything about Mike Foale's experience onboard Mir, it affected all parts of the Shuttle-Mir Program on the ground. Program Manager Frank Culbertson was again wakened with news of a dangerous accident onboard Mir. He and other NASA managers now had to determine what had happened, what the risks were to future U.S. Mir astronauts, and whether to continue the program.

On June 25, 1997, at Mission Control-Moscow, things were going along like most other Shuttle-Mir days. According to Operations Lead Keith Zimmerman, "It was just a regular communications pass coming up, so I went down into the main room to sit on our console. By pure coincidence, I happened to take an interpreter with me that day..."

Zimmerman plugged his headset into the console, expecting a normal day and an average Progress docking. But, when the communications pass started, he noticed the crewmember on Mir was talking very fast. "My Russian's okay," Zimmerman said, "but I could only catch a few words." The words he heard were "Progress" and "Spektr." And then, Zimmerman said, "The interpreter got a really funny look on his face, and he said, 'I think they hit something.' It was just the very curious way he said it. I was thinking they hit their hand or something like that."

Zimmerman asked his interpreter to explain, and he was told, "Progress hit the Spektr module." Now, Zimmerman could hear Mir's alarms sounding in the background. He looked at the display and saw the space station's air pressure was starting to

drop. "At that point, everyone ... realized, 'Uh-oh, we've got a really serious problem here.'" Within minutes, people were pouring into the control room.

Vladimir Solovyev, the senior Russian Flight Director, had been over in the Progress control room because, during dockings with Mir, the Progress is the "dynamic"—or the moving—vehicle. Solovyev now came into the Mir control room, and he began managing both control centers. According to Zimmerman, Solovyev "just started issuing orders," saying things like, "'Okay, you guys do this.... You guys do this.... Commander [Tsibliev], go do this.... Mike [Foale], do this.'" Solovyev directed the Mir crew to get out some of the air tanks that were used to repressurize Mir after spacewalks. "He told them, 'Get one of those and start opening it now, to kind of keep the pressure up while the leak's still going on—to give you more time to close the hatch.'"

The Mir crew had closed the hatch to the Spektr module by the end of the communications pass. According to Zimmerman, "The hatch appeared to be holding, but there was no guarantee." Then, the communications pass ended. On the ground, an anxious discussion began: "Was the crew coming home? Was the hatch going to hold? Are we going to come up [again] in an hour and give them a call, and the crew won't be there because the hatch didn't hold and they're in the Soyuz now?"

Zimmerman phoned Program Manager Frank Culbertson, waking him at about three o'clock in the morning, Houston time, to tell him all that was known at that point. Zimmerman and Flight Surgeon Terry Taddeo then put in a call to Mike Foale's wife, Rhonda, and they set aside one of their telephones to be used solely for Culbertson and for Foale's family.

About an hour passed before the next communications pass. But, it seemed to arrive as Zimmerman said, "before you could even really blink. It seemed like the hour was over and it was time ... to see: Was it still holding together? And, sure enough, the first thing [the controllers] said to the crew was, 'Are you there? Okay, you're there. Good. What's the pressure? You're not on the Soyuz? That's the first thing. Okay.'" The Mir crew reported the pressure, and it appeared to be holding.

There followed several days of Mir attitude recovery and power problems, but the main, immediate crisis had passed. On the ground, the Shuttle-Mir teams hustled to save what they could of Mike Foale's science program and to gather replacement supplies to be sent up to Foale on the next Progress vehicle.

The collision would shuffle the assignments of at least three NASA astronauts. Before the mishap, Wendy Lawrence, Lawrence's backup David Wolf, and Wolf's backup Andy Thomas had been continuing their training at several locations in Russia, including the Gagarin Cosmonaut Training Center in Star

City and in water survival simulations in the Black Sea. The accident newly demonstrated the need for the U.S. Mir astronaut to be able to perform spacewalks wearing a Russian Orlan extravehicular activity suit. This, in effect, denied Wendy Lawrence her upcoming Mir opportunity because she did not fit the suit. (Lawrence had earlier been disqualified because she didn't fit the Soyuz escape capsule. But new size restrictions requalified her until the Orlan suit became an issue.) Wolf was moved up into her place, although he had to undergo even more intensive training to be ready for his flight. Andy Thomas, who as Wolf's backup had not been scheduled for a Mir residence of his own, would soon be moved into Wolf's former slot as the last NASA-7 Mir astronaut.

In the United States and Russia, several teams investigated the safety aspects of continuing the Shuttle-Mir Program, and all found that the program should continue. Johnson Space Center Director George Abbey appointed a Mir-Progress Mishap Investigation Team, chaired by astronaut Michael Baker, who had commanded the Mir docking mission the previous January. Program Manager Frank Culbertson led a comprehensive Flight Readiness Review. Former astronaut Fred Gregory, NASA's Associate Administrator for Safety and Mission Assurance, led a separate internal review. General Thomas Stafford led an independent Safety Review Panel, which included Dr. Ralph Jacobson, President Emeritus of the Charles Draper Laboratories. Finally, Thomas Young, member of the National Academy of Engineering, led yet another independent group that looked at an Inspector General's Report to Congress about the safety of the Shuttle-Mir Program and at NASA's handling of it.

Inspector General Roberta L. Gross cited several areas of concern about Mir and its operations. These included the Soyuz capsule's viability as an escape vehicle; Mir fire hazards; oxygen and carbon dioxide management problems; crew fatigue and stress; ethylene glycol exposure from leaking coolant systems; astronauts' training and systems-knowledge limitations; and U.S.-Russian communications problems. The letter even cited the Russian cosmonaut pay system as a possible contributor to safety problems, because the cosmonauts were paid bonuses whenever they performed higher-risk procedures, such as the manual dockings of Progress vehicles.



On September 18, 1997, Program Manager Frank Culbertson testified before the House Science Committee. Chairman James Sensenbrenner, Jr., remarked, "There has been sufficient evidence put before this hearing to raise doubts about the safety of continued American long-term presence on the Mir." In his response, Culbertson focused on "two broad questions." First, "Is there sufficient value and benefit to be gained from continuing the missions aboard Mir?" Second, "Can we conduct those missions safely?" He addressed the safety question, point by point, and he returned to

the question of value by saying, "There is much more to be learned. When you are exploring new territory or preparing yourself to take a major step into the unknown, who can say when you have learned enough?"

For its part, the Stafford group concluded, "Not only is the Mir [Space] Station deemed to be a satisfactory life support platform at this time, but it is anticipated that significant operational and scientific experience is still to be gained through continued joint operations." The Young Panel found, "The safety issues cited in the Inspector General's report have been analyzed and assessed by [the] NASA Phase 1 Team. NASA has an adequate safety assessment process that is complete and thorough. We found no safety concerns that were not being considered by NASA safety assessment processes." The Young Panel concluded that the corrective action already taken by NASA had made both the future use of the oxygen-generator canisters and the probability of a repeat of the collision and decompression incident "to be acceptable risk." However, the Young Panel did call for additional failure analysis of the oxygen canisters, more timely corrective actions for problems that might occur in the future, and the inclusion of "safety and mission assurance" inputs by U.S. Mir astronauts as a formal part of the review process for critical Shuttle-Mir functions.

Describing his ordeal in deciding whether to fly the next astronaut, David Wolf, to Mir, NASA Administrator Daniel S. Goldin said, "I wouldn't want to inflict this pain" that he had been going through "on any human being. Believe me, I don't sleep nights. And, there's only one thing that has been on my mind for weeks now—the safety of our American astronauts."

David Wolf later discussed the decision process from his perspective. "It put our leadership—Mr. [George] Abbey, Dan Goldin, and Frank Culbertson particularly—in a tough spot, because here they had to say [that] something which is inherently never fully safe is safe enough. So, I applaud their leadership in this. I also applaud the good questions that people like [House Committee Chairman] Mr. Sensenbrenner and other critics ... brought forward, because if we couldn't accurately ... address those questions, ... then we really didn't have any business flying. History showed that it was the right decision. But, those were good questions and we had an obligation to answer them."

Wolf went on. "Now, on a more philosophical level, it's easy to be good partners ... with the Russians when things are going easy. But, it's when things are difficult that we really can show what good partners we will be."

Philosophical questions aside, the decision to fly Wolf instead of Wendy Lawrence was handled professionally by all involved. During a press announcement at the time, Culbertson described what had gone into it. "Making a change in crew assignments or the flight plan for a particular crew is one of the most difficult

decisions we have to deal with in a program like this ...



"As events occurred on the Mir, it became clear ... that having Mike [Foale] as a qualified EVA crewmember was a critical component of the mission. We started thinking ... whether that should be a factor in future missions. My first preference, of course, would have been to have Wendy

Lawrence qualified as an EVA crewmember. We looked at her qualifications and what 'fit-checks' she had experienced [for the Russian EVA suit], and it became clear fairly quickly that she was not qualified to operate in the Orlan suit just because of size."

The other alternative was to evaluate her backup, David Wolf. Wolf had had almost 150 hours of extravehicular activity training in the United States. Culbertson said, "It became apparent that we would be wiser to respond to the reality of the situation, and maximize our resources and participation, and see if there was some way that we could have David trained in the Orlan suit, ... and whether there was enough time to do that." Both Lawrence and Wolf were trained on the science program and the Mir systems. Either one could have operated as a full crewmember. The only deciding factor, Culbertson said, "was whether we thought it was important to have the potential for EVA participation during this upcoming mission."

Wendy Lawrence would later fly to Mir, along with David Wolf as STS-86 crewmates. Wolf later related, "Wendy was still a critical part of the mission [i.e., Wolf's mission on Mir]. In fact, I could not have succeeded at this without her. She knew more about the planning of the transfer, and placing gear, and what all the gear was than I did, of course. So, she went up and just made things work fast—up onboard—and got me organized and off on a great start."

▶ [Read the Congressional Mir Safety Hearing document](#)

▶ [Read the Administrator's Letter to Congress  
Concerning the Shuttle-Mir Program](#)

▶ [Next Chapter - STS-86: Loaded with Experience!](#)

| [TOC](#) | [Site Map](#) | [Photo Gallery](#) | [Video Gallery](#) | [Diagrams](#) | [Welcome](#) | [Search](#) |