MICHAEL MOSES REMEMBERS feeling giddy that day in February 2005 as he walked into chief flight director Milt Heflin’s office at NASA’s Johnson Space Flight Center in Houston to accept his new job. Among space engineers, becoming a flight director is a crowning career achievement, and Moses half-expected Heflin, known as Uncle Milly, to give a round of high-fives to the nine newly selected directors gathered in the room. But Heflin’s words were sober. “We got an hour-long lecture that this is dangerous business, that we are on the pointy end of the sword, and that if we screw up, somebody dies,” Moses recalls.

Not exactly welcoming, the lecture at least had an impact. “That night I hardly slept,” says Richard Jones, who like Moses had worked for years in mission control before being promoted to flight director. Another new flight director, Holly Ridings, whose previous job in mission control had been monitoring the attitude of the International Space Station (ISS) in orbit, says that now, “every time I sit down in the flight director chair, there is a little piece of my mind that thinks, ‘If things go really wrong today, the U.S. space program could be over—or at least grounded for a very long time.’”

Months later, when Heflin asked Moses why the shock treatment was necessary when all the new recruits were already battle-hardened veterans, he answered, “Humility was something they needed to pay attention to right away. They could not leave pounding their chests.”

For one thing, he says, “there were a number of people who weren’t in the room who were just as qualified to be sitting there with them.” And the new directors will still rely heavily on those people’s judgment. The flight director sees the big picture during a spaceflight, but it’s the individual flight controllers sitting at 19 consoles—from the propulsion engineer to the booster systems engineer to the flight surgeon—who supply the critical details. Moses, Jones, Ridings, and all but one of the other new flight directors had been reared as NASA flight controllers, in fact. Last year, a spate of retirements and promotions in mission control freed up nine coveted slots for flight director, bringing the total number to 30. It was the second largest collective hire since the job was created in the early days of the space program.

A quick demographic profile of the Class of 2005: Six men and three women, all but one in their 30s. Three native Texans, four from northeastern states, two from the Midwest. The class includes the first African-American flight director, 34-year-old Kwansi Allbaruh of Maywood, Illinois, an MIT graduate who joined NASA in 1995 as a space station life support systems officer. And while most of the nine have engineering degrees, 43-year-old Robert Dempsey, a former space station controller for communications and tracking, is also an astronaut, having worked at the Space Telescope Science Institute in Baltimore in the early 1990s. All are whip-smart, and all are high achievers.

Last December I spent a day at JSC with the new recruits as they went through their training exercises. By 7:30 a.m., Dempsey is already “on console” in the Flight Control Room (FCR), or “flicker” for the space station. He hands me a set of headphones so I can listen to the comm loop, an open channel between mission control and the orbiting astronauts.

The station flicker is called the Blue Room. There’s also the Red Room, used for ISS training, and the White Room, the shuttle flicker, the room Hollywood usually depicts in films. Today’s task in the White Room is a simulated docking between the shuttle and the station, with new flight director Michael Sarafin in charge. Before his promotion Sarafin worked in mission control for 10 years as a guidance, navigation, and control officer. He was on duty during the 2003 Columbia accident, but doesn’t seem eager to discuss it, at least not with a journalist. “It was a hard day to lose our friends” is all he says.

In today’s scenario, the shuttle (a simulator in another room) will perform a two-minute burn of its twin Orbital Maneuvering System engines. The aim is to boost the vehicle into a higher orbit to rendezvous with the station. Two floors

BY MICHAEL BEHAR

Tough under pressure: Space station flight director Mark Ferriing at his console during last year’s STS-154 mission.
above, the simulation supervisor, or "sim-sup," and his cohorts will try to confound the flight controllers with any number of curve balls. "They might cause a fire, cabin leak, loss of communications, loss of critical flight control systems, or loss of jet thrust," says Sarafin. "They are pulling the puppet strings behind the scenes. Our job is to react to what they do."

The engines fire and mission control falls silent. The exact positions of the shuttle and ISS are projected as a high-resolution graphic on a 10-by-12-foot overhead screen. Another large display plots the orbits of the shuttle and station onto a world map. A third screen relays telemetry data, caution messages, and emergency warnings from the shuttle and ISS to mission control. It's only a simulation, but I'm transfixed by the realism, knowing that all hell is about to break lose. Suddenly, a yellow warning code indicates three separate temperature spikes in one of the avionics bays that house the shuttle's flight control and computer systems. The EECOM (emergency, environmental, and consumable operations manager), pronounced "ee com," calmly flips through her mission rulebook ("Our bible," says Sarafin) to find the right protocol and determines—with the help of other flight controllers—that the spikes are caused by a small blockage in the water-cooling loop. Switching to a redundant cooling loop returns the temperatures to normal.

It's this particular EECOM's first simulation in the flicker front room, a significant milestone for her. She's already endured hundreds of similar exercises in the "back room," where junior flight controllers work in specialist teams, training on exercises that range from long-haul flights to similar exercises like this. She's been training for months, alternating between the psych ward, gastrointestinal, and pediatrics. So goes the arc of a career in mission control—back room to front room to flight control. Shuttle simulations might last three or four days, and to get certified to work an actual launch and landing, a flight director must have completed hundreds of simulations before doing it for real. "They give you all these failures—to the point where it is almost unrealistic—to see how well you react," says Ridings.

So even after hundreds of hours of practicing fast-fetched disaster scenarios, real missions occasionally turn up surprises. One frequently cited by flight directors is the March 1992 STS-49 mission to rescue the Intelsat communications satellite stranded in an unusable orbit. The shuttle crew's task was to attach a new rocket motor to the satellite that would boost it to the proper altitude. The original plan had been for a spacewalking astronaut at the end of the shuttle's robot arm to nudge the satellite with a special capture bar and bring it into the shuttle cargo bay. When that failed several times, the astronauts themselves proposed a workaround: Send out three spacewalkers, which had never been tried before, to grab the two-ton beast by hand and coax it into the bay.

It worked. But after the astronauts attached a booster rocket to the satellite and reentered the shuttle, another glitch occurred. When the crew flipped a pair of switches to activate a spring that would eject the satellite from the shuttle, nothing happened. "Now we're sitting there with a satellite in our payload bay, with a rocket motor that might be getting ready to fire," recalls Phil England, who was a flight director for the mission.

Stumped by a potentially dangerous situation they'd never trained for, the ground controllers set to work. England later recalls that when he first sent the emergency communications to mission control's most famous "save" after an oxygen tank on the Apollo 13 spacecraft exploded on the way to the moon in 1970, "There's a gut feeling, an almost intuitive response to things that are happening around you," he says. "It's like chess," says astronaut and NASA head of spaceflight Bill Readdy. "You have to always think several moves ahead.

"So it was with an emergency on the spacewalk on Super Bowl Sunday, February 3, 2002. When a software glitch took down the station's Russian-run computer, the crew determined that the Russian-run computers were working, including the one in the booster rocket, "There was no way to jumpstart it."

"People call you at two in the morning, or on vacation, it doesn't matter," says Ridings. "When you're working a big mission, you get home after a shift and immediately turn on NASA TV. It's addictive."

Not sure how long the computers would be down, and never having trained for a triple-computer failure, Lumney turned to his PHALCON (power generation, storage, and power distribution) flight controller, who offered a simple, almost primitive solution: Have the crew look out the window, find the sun, and manually rotate the arrays toward the light. "He came up with this procedure on the fly," says Lumney. "It had never been done before.

"After roation the arrays toward the light, the station powered itself up. The "PEOPLE CALL YOU AT TWO IN THE MORNING, OR ON VACATION, IT DOESN'T MATTER," SAYS RIDINGS. "WHEN YOU'RE WORKING A BIG MISSION, YOU GET HOME AFTER A SHIFT AND IMMEDIATELY TURN ON NASA TV. IT'S ADDICTIVE."

director who was in the public spotlight as NASA's shuttle program manager at the time of the Columbia accident. It was Gene Kranz who first scribbled "tough and competent" on a mission control checklist board after another disaster— the first that killed Apollo 1 astronauts Gus Grissom, Ed White, and Roger Chaffee during a ground test in 1967. Kranz demanded that flight directors write the words on the blackboards in their offices, and that they be able to recite them—probably the simplest, most effective phrase in all of aviation—Kranz was a fighter pilot before join-
mutual loyalty that extend well beyond working hours. “We knew each other very personally as a family,” Kranz says of his time at the space agency. “We parted together. We had the largest party fund in all of the federal government. We would take over the Astrodome. It basically helped us maintain our bond.” Not much has changed. “Being a flight director is not a job but a lifestyle,” says Ridings. “You know everybody’s kids, wives, and husbands. People call you at two in the morning, or on vacation, it doesn’t matter. When you’re working a big mission, you get home after a shift and immediately turn on NASA TV. It’s addictive.”

It’s also demanding. The job is grueling mentally, and the nine-hour shifts go round the clock. Flight directors regular-ly have to adjust their sleep schedules. “Everyone has a really good set of blinds at home,” quips Dana Weigel, who was a flight controller for extravehicular activities (spacewalks) before she was promot- ed to flight director.

The key to success, Sarafin explains, is learning how to handle potentially dil- eat- ing stress. He describes a condition called “scope lock” that sets in when a frazzled flight director or controller gets too focused on the minutiae of a particu-lar problem “and forgets that there is a spacecraft flying up there.” They lose sight of the big picture, hyped out by the dizzying stream of data spewing from their con-soles. “Others start to ramble when the point of keeping track of how many hours they were working,” he says. “I’d tell them to slow down, to go home, and find a way when they get in their cars at the end of the day to leave the job behind.”

Sarafin says he learned the importance of time management and keeping his priorities in perspective. “I learned that not everything is as important as it seems at the time,” he said. “I learned to focus on the big picture, not just on the details.”

Dr. LEROY CAIN was a flight director during a 2005 simulation. Mission control is in the media spotlight more than ever following the Columbia accident. Above: By tradition, astronaut “capcoms” like Barbara Morgan and Michael Massimino are the ones who talk to crews in orbit.

moon program is to stay for the long haul—to learn how to live on the lunar surface. That will mean rethinking the crew’s relationship with mission control. “Right now we schedule the crew’s time in five-minute chunks,” says flight direc-tor Ginger Kerrick. “We know that’s going to have to change.”

Dempsey has been involved in planning an exercise for an upcoming space station mission “where we say to the crew, ‘Okay, here are the key things to get done, here are your time constraints, now you plan it yourselves.’” The idea is to give the astronauts the freedom they’ll need for lunar missions lasting months or even years.

An important part of this approach will be onboard autonomy, software systems that enable the crew to resolve a crisis when lengthy communications delays— in the case of Mars, up to 22 minutes, de-pending on the positions of the planets— make it impossible to talk to the ground in real time. “Instant problem resolution will have to fall on the astronauts’ shoul-ders, not ours,” says Dempsey. “When there’s an onboard fault, it can’t just be a light that turns on. Today, when that light comes on, the guy sitting next to me tells the crew what page of what book to turn to. In the future, the software systems will have to do that for them.”

Both Dempsey and Dittmer, who retired from NASA shortly after the Columbia accident, make the inevitable comparison to HAL 9000, the omnipotent, omnipresent computer in 2001: A Space Odyssey. “Of course the system would be psychotic,” says Dittmer, “or necessarily super intelligent, or even completely autonomous. But smarter than the software we have now.” Ditte-more says that some small steps have been taken in this direction, such as the Integrated Vehicle Health Monitoring system, flown on shuttle mission STS-95 in October 1998. IVHM uses a network of pressure, temperature, strain, and other sensors to monitor the vehi-cle’s condition without aid from mission control, and even to do some limited troubleshooting.

The nine new flight directors are helping to plan the next generation of NASA space vehicles, even while their main re-sponsibilities still lie with the shuttle and space station. I accompany Weigel and ano- ther new director, Brian Smith, to a meeting with the deputy project manag-er for the Crew Exploration Vehicle, or CEV, the upgraded Apollo-style capsule that will ferry astronauts to the moon and back beginning in the next decade.

We gather around a circular table inside JSC’s Building 9, a massive hangar that houses, among other things, a life-size training mockup of various space sta- tion modules. When we arrive, instruc-tors are conducting a simulation of a cabin fire, complete with billowing white smoke and blaring alarms. Directly behind us is a metal skeleton of the CEV, the frame-work for a full-scale model. For now, it’s flight controllers to keep tabs on every-thing in the spacecraft, such as naviga-tion, guidance, communications, pay-load, life support, software, and extravehicular activity. Instead of strings of numbers, the modern CEV displays have easy-to-interpret graphics. “It gives flight directors a three-dimensional visual-ization of what’s going on,” says Kranz.

“With Apollo 13, it took us almost 25 min-utes to figure out we had an explosion. Whereas in today’s world, they would have known it instantly.”

But improved or not, these are still just tools. For the foreseeable future, flight di-rectors will continue to rely on their own intuitions and instincts more than on technological wizardry. “It’s the human element that allows them to be successful,” says Ready. “The danger is in losing sight of that, of relying too much on tech-nology. During the 1990s, when the shut-tle was flying several times a year, he says, “there was an attempt to depersonalize the flight director’s job. It wasn’t about the people, it was about the science and that has its ‘antiseptic and routine, he observes. Even as they drill endlessly, routine is something the flight directors try to avoid. When it comes to spaceflight, a sense of routine can lead to trouble. “I’m not go-ing to sugarcoat it,” says Jones. “Ronald Reagan deemed the shuttle operational after the third or fourth flight. ‘Opera-tional means to all of us you have learned to learn about the vehicle. That set a tone. Apathy set in. And NASA got in that mode that leads to accidents.’”

Being a flight director, says Kranz, is “about being on the edge.” A word that Kranz is “about being on the edge.” A word that U.S. space program could come to a halt because of something that happens on your next shift. No wonder, then, that hearing the way the old “new job” speech was so somber.