

Return to Flight team completes first marathon simulation

The long haul

by Kendra Phipps



Ever have one of those days?

Return to Flight Space Shuttle Commander Eileen Collins is having one. Her STS-114 crew is battling an electrical short in a crucial laser – one that helps inspect Space Shuttle *Discovery* for damage and aids in docking to the International Space Station – and struggling to restart a malfunctioning fan in Soichi Noguchi's spacesuit. The suit may be a no-go for tomorrow's spacewalk, and now Mission Control is calling with updated coordinates to be programmed into the Shuttle's robotic arm.

The good news is that the crewmembers, along with dozens of flight controllers and other experts, are calmly working through these issues like the pros that they are.

The even better news is that it's all part of an elaborate simulation – the real mission is still weeks away.

"The long sim is great practice for us," Collins said. "We've been training on these tasks for a year and a half, but this allows us to put it all together."

This "long sim" is a rigorous 36-hour dress rehearsal of the mission's second and third days, which includes orbiter inspection activities and Space Station rendezvous and docking.

Lead Flight Dynamics Officer, William H. Tracy, takes part in a mission simulation run.

A simulation this complex takes weeks of planning.

The STS-114 crewmembers have been training together since October 2003. These seven – Commander Collins, Pilot James Kelly and Mission Specialists Charles Camarda, Wendy Lawrence, Noguchi, Stephen Robinson and Andrew Thomas – have worked as a cohesive unit for countless hours. They have rehearsed intricate spacewalks, studied possible tile repair techniques and gone over mission checklists in Shuttle simulations. However, this long sim is their most intense challenge yet.

A multi-stage dress rehearsal

This rehearsal plays out on many stages. The crew itself splits its time between the Shuttle Mission Simulator and the Space Station Training Facility.

Across the Center, the Shuttle and Space Station Flight Control Rooms are also buzzing, along with the Simulation Control Room and numerous "back rooms" of supporting cast members. Extra eyes and ears scrutinize every step of the simulation, looking for any room for improvement.

Mission simulations that involve the control teams in this way, called integrated sims, are as much about the Earth-bound teams as the crew.

Long sims are useful for practicing "the standard communication, coordination and teamwork objectives between the crew and the flight control teams," said Simulation Supervisor Darrel McGregor with United Space Alliance (USA). McGregor is the wizard behind the curtain who makes this simulation happen.

Paul Hill, lead flight director for STS-114, agreed.

"It's important to wring this out as much as possible in the integrated environment to make sure we're ready for whatever comes our way," Hill said.

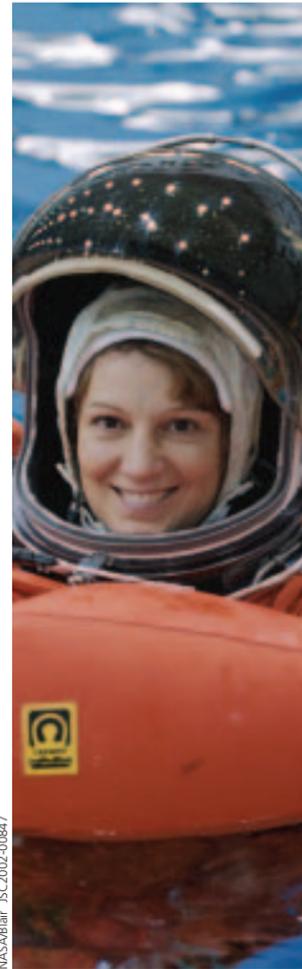
During this sim, Shuttle flight controllers work for the entire 36 hours in Mission Control. They rotate teams around the clock, making any necessary schedule adjustments at each shift change. As for the crew, the astronauts spend virtually every waking hour for two days in the Shuttle simulator.



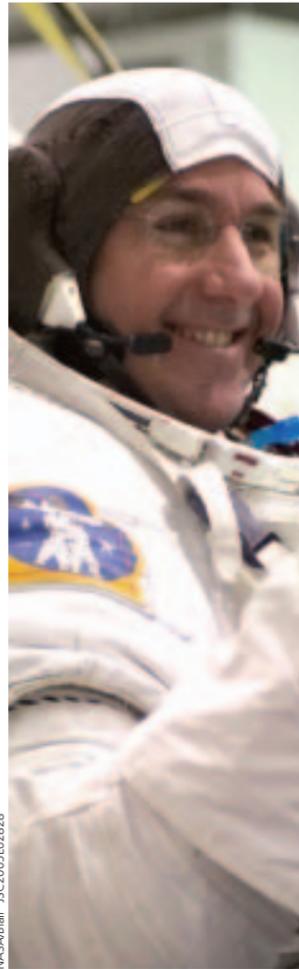
STS-114 Lead Flight Director Paul Hill participates in the simulation.

The first 24 hours rehearse the first two days of the mission, much of that time involving a new, highly detailed inspection of the Reinforced Carbon-Carbon on the Shuttle wings' leading edges and nose. The crew practices using a new boom with laser sensors at its end that extends the reach of the Shuttle's robotic arm to scan those surfaces.

The crew of STS-114 prepares for Return to Flight.



Eileen M. Collins



Stephen K. Robinson



Charles J. Camarda



James M. Kelly



Wendy B. Lawrence



Soichi Naguchi



Andrew S. W. Thomas

The Space Station flight controllers then join the simulation during its last 12 hours for the rendezvous and docking activities. They rehearse a new nose-over-tail “flip” the Shuttle will perform as it approaches the Station to allow photographic inspection of its underside heat protection tiles. They also practice a new robotic “handoff” of the boom extension from the Shuttle’s robotic arm to the Station’s robotic arm.

Choreographing the chaos

A simulation this complex takes weeks of planning. McGregor and his simulation planning team worked with Shuttle and Space Station trainers to come up with timelines and objectives, which are then culled down into a final script.

While everyone’s ultimate goal is a flawless mission, the best way to get there is not through a flawless simulation. McGregor and his team deliberately write dozens of malfunctions and mishaps into the sim script. These are not randomly selected errors, either.

“The instructors for each discipline provide ideas on which failures would be best to meet the desired objectives,” McGregor said.

During the sim itself, the malfunctions are thrown into the mix by simulation instructors down the hall from the crew. With a few keystrokes or mouse clicks, the crew has a new challenge. Usually, many more problems are added during a sim than would actually happen on a mission; this keeps the entire team – astronauts, engineers and flight controllers – on its toes.

As for the instructors, their current task – throwing wrenches into a simulation – may seem sinister, but it is a critical part of spaceflight training and it tests how well they’ve done a larger part of their jobs. They spend most of their days working with crewmembers one-on-one and teaching them how to use the very systems that they are now deliberately breaking.

“I think this is one of the greatest jobs in the world: knowing that you have a hand in training a crew in real procedures that they’ll use in the mission,” said USA’s Chris Edwards, Data Processing Systems and Navigation instructor. His USA colleague, Michael Grabois, agreed.

“I’m on the front lines of a Shuttle mission,” said Grabois, Space Shuttle Systems instructor. “Training is the next best thing to flying.”

One down, two to go

The crew presses forward through the glitches being sent their way. When the 36 grueling hours are up, they will review their lessons learned from the simulation and get right back to training again.

Most Shuttle crews would only have to get through one long sim or none at all. But for this mission, several of the marathon training sessions are being used to get the crew and

ground teams in top shape: another 36-hour sim is coming up, followed by a 48-hour session.

The number of long sims for STS-114 is partly due to the complexity of the mission, and partly to the fact that the Shuttle fleet has been grounded for nearly two years. Sims such as this one help everyone get focused.

“We’re definitely approaching the peak of training,” Hill said. “The sims are becoming more difficult, with more problems to solve.”

Prior to this, Collins said her longest simulation for a Shuttle mission lasted about 10 hours. But she said she can already appreciate the benefits of the extended rehearsals.

“This gets us in the correct mindset,” she said. “It gets us in the mode of flying again.”