

# Orbital care

When a cooling problem threatened the space station, Boeing teams worked together to help find solutions

By Sean Elizabeth Wilson

The problem last July on the International Space Station (ISS) was potentially serious.

A power spike had tripped a circuit breaker for one of the liquid ammonia pumps for the station's cooling system. The pump, one of two on board, shut down as planned, which knocked out half the station's cooling system.

"The ISS was in a very risky posture," said Felipe Saucedo of Boeing's Vehicle Integrated Performance and Resources (VIPeR) team in Houston. Astronauts would have to replace the pump during several unplanned spacewalks.

Sixteen days after the ammonia pump shut down, the repair job was done. Emergency resolved.

Space exploration is a risky

business, and that includes living and working in the International Space Station some 220 miles (190 nautical miles, or 400 kilometers) above the earth. Helping to keep the station running smoothly and safely is the job of Boeing's VIPeR team.

Four subteams are responsible for such things as the station's flight attitudes, solar array management, mass properties, power and thermal resources, as well as its propulsion systems. As situations arise, including a spacewalk or rendezvous and docking of a visiting vehicle, the teams lead the analysis that ensures uninterrupted performance of the station.

"We have to ensure the entire space station operation sequence works," said Ivan Berrios, manager of Boeing's VIPeR team.

Each of the teams has a specific area of expertise and focus; the teams don't often address common issues. But when the ammonia coolant pump module located outside the station failed last summer, the teams worked together to ensure the safety of the station and those on board, according to Saucedo, lead for the VIPeR team.

Team members worked around the clock during the emergency in NASA's ISS Mission Evaluation Room, advising operations personnel on minimizing the risks involved.

"The VIPeR team looked at temperatures and identified equipment that could remain functioning without violating operations temperatures," Saucedo said. "We got the solar array constraints

together to provide robust plans so the arrays didn't have to be moved during the events and made sure thermal limits would stay within nominal parameters."

The safety of the astronauts during the three spacewalks was another important consideration.

"For the spacewalkers to be safe outside of the station, we analyzed fault tolerances to mitigate the risk of propellant leakage or inadvertent thruster firings ...," said Ulhas Kamath, lead for the Propulsion team.

Because the failed ammonia pump module was so large, it had to be temporarily stowed on the station's Mobile Transporter to make room for the crew to install the new pump. Placing such a large piece of equipment in a new location on the station's structure meant the team needed to develop new mass properties for the station.

"The mass of the structure shifted," said Greg Ray, team lead for the Mass Properties team.

During the spacewalks, ammonia and nitrogen were vented from the ammonia pump lines. In the vacuum of space, these gases turn into hard particles that can cause significant damage if they hit the station.

"We provided potential vent location information and flight attitudes to the

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— Felipe Saucedo of Boeing's Vehicle Integrated Performance and Resources team

engineering and operations community," said Shawn Conerly, engineer for the VIPeR team. "The analysis showed that once these particles were ejected, they didn't re-contact with the station or damage any external hardware."

The performance of the Boeing ISS teams during the emergency earned them recognition from Boeing leadership, as well as a team award from the space station crew they supported.

But the best reward for the team is daily providing their specialized support to the space station program.

"It is very satisfying to know we have a big input to what the operations community has to do every day," Saucedo said. "It is always very dynamic." ■

edmund.g.memi@boeing.com

**PHOTOS: (Left)** Astronaut Doug Wheelock emerges from the space station for the second of three spacewalks last August to remove a failed ammonia coolant pump module on the station's S1 truss. **NASA (Below)** Boeing VIPeR team members Mark Krajchovich (left) and Suzanne Oliason are ready with Boeing support in NASA's International Space Station Mission Evaluation Room. **ELIZABETH MORRELL/BOEING**

