Boeing Power and Cooling Systems to be Activated on International Space Station

The Boeing Company's [NYSE: BA] primary electrical power and cooling systems on the International Space Station (ISS) will go live during Space Shuttle Discovery's next ISS assembly mission.

Astronauts, Boeing engineers and NASA mission controllers will orchestrate a precise ballet of powering down equipment, transferring it to other power channels and then plugging and unplugging more than 140 electrical connectors. The ISS power system will transition to its permanent configuration by rerouting power through electrical components on the Port 1, Starboard 0 and Starboard 1 trusses for the first time.

Boeing engineer Mimi Lovato, Electrical Power System (EPS) flight lead, and her teammates have been preparing for this mission for several years. "It's exciting because it is the next step in prepping for the arrival of the other space station power modules," she explained. "The flight control team has simulated this mission many times, and we have confidence in our hardware."

Like a city's central power plant, the station's giant solar arrays generate primary power at levels too high for consumer use, ranging from 137 to 173 volts direct current (Vdc). The power is regulated between 150 to 160 Vdc, and then routed to batteries for storage and to four Main Bus Switching Units (MBSUs) that route it to distribution networks.

Eight independent power channels (corresponding to each solar array wing) feed the MBSUs, which output the electrical loads. Under normal operations, each power channel supplies power to a specific set of loads. However, if a channel fails, the MBSU directs power to those loads from another channel, greatly enhancing the system's reliability.

DC-to-DC converters "step-down" the primary 160 Vdc stream to a tightly regulated secondary power of 124.5 Vdc and distribute it to laboratories, living quarters and individual users.

Even though the station spends about one-third of every orbit in the Earth's shadow, EPS will continuously provide 84 kilowatts of usable power once all eight solar array wings are on orbit. Boeing, through its Rocketdyne Propulsion and Power division (now Pratt & Whitney), built the EPS hardware and provides sustaining engineering support to NASA.

The high voltage of Boeing's power system meets NASA's test bed research requirements and reduces ohmic power losses through wiring while permitting the use of smaller, lighter power lines.

The original U.S. electric power system configuration, which powered up with the installation of the first solar array power module in November 2000, has consistently provided reliable power exceeding ISS program requirements and expectations as it has safely supported continuous human presence for six years. This latest development in the assembly and activation of the power system further enhances safety and reliability for current and future Expedition crews, while paving the way for additional PV modules and the international partner elements.

During the mission, astronauts and mission controllers also will activate the station's Boeing-designed External Active Thermal Control System for the first time. The system cools the power system's electrical boxes using liquid ammonia and a series of looped radiator panels, which dissipate the heat into space. Ammonia is used because of its low freezing point and thermal properties; a non-toxic internal water coolant loop within the labs and living modules also is used.

"The purpose of this cooling loop is to flow ammonia around heat exchangers and cold plates at a controlled temperature," said Matt Jurick, a member of Boeing's External Active Thermal Control Systems team and lead thermal engineer for the flight. "The mission is closely coordinated to ensure that we have enough time to activate the cooling loops after the EPS components are activated."

The shuttle mission also will deliver the 4,110-pound Boeing-built Port 5 (P5) truss, which will be attached to the P4 truss element. P5 connects power, cooling lines and serves as a spacer between the P4 photovoltaic module (PVM) and P6 PVM. P6 will be joined to P5 during a later assembly mission.

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