A high-power journey

Boeing-built primary power, cooling systems to be activated on ISS

By Ed Memi

NASA PHOTO

Astronaut Daniel C. Burbank is shown on the International Space Station's P3/P4 truss during a spacewalk on mission STS-115. During the upcoming STS-116 mission, the power from the photovoltaic module, named P4, will be routed through the permanent ISS electrical power system, which is being activated. Boeing will assist NASA during the activation.

Think about wearing a bulky spacesuit while connecting and disconnecting power cables about 140 times—while in a weightless environment. That's the task awaiting astronauts of the Space Transportation System-116 mission, to be flown on Space Shuttle *Discovery,* when they head to the International Space Station in December.

Spacewalking astronauts will rewire the Electrical Power System (EPS). Astronauts, along with Boeing engineers and NASA mission controllers, will orchestrate a precise ballet of powering down equipment, transferring it to other power channels, and unplugging and plugging in electrical connectors. The ISS power system will transition from a temporary to its permanent configuration when power is rerouted through electrical components on the Port 1, Starboard 0 and S1 trusses for the first time.

Boeing engineers Mimi Lovato and John Barber, flight leads for EPS, have been preparing for this mission for several years. "It's exciting because it's the next step in prepping for the arrival of all the other power modules" for the ISS, Lovato said. "The flight control team has simulated this mission many times, and we have confidence our hardware will work."

Like a city's central power plant, the station's giant solar arrays generate primary ISS power at levels too high for consumer use, ranging from 137 to 173 volts direct current (Vdc). The power is regulated between 150 and 160 Vdc and then routed to batteries for storage and to switching units that route it to distribution networks. DC-to-DC converters step down the primary 160 Vdc electricity to a tightly regulated secondary power of 124.5 volts for use on the ISS.

Even though the station spends about one-third of every orbit in 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 part of Pratt & Whitney), built the EPS hardware and provides sustaining engineering support to NASA.

Lovato and the Boeing team of EPS engineers will be supporting NASA during the extensive reconfiguration. "This mission has a lot more configuration changes that make it more complicated than earlier missions," Lovato said.

The power system electronic boxes are cooled by a thermal system that will be activated for the first time during STS-116. In the system, excess heat is removed by liquid ammonia coolant in tubes that loop through radiator panels, which dissipate the heat into space. Ammonia is used in the external lines that transfer heat to the radiators because of its low freezing point, but an internal water coolant loop in the labs and living modules interfaces with the external loop. Boeing engineers in Huntington Beach, Calif., designed this cooling system, called the External Active Thermal Control System.

"The whole 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 Active Thermal Control Systems Team and lead thermal engineer for the flight.

The shuttle mission will also deliver the 4,110-pound (1,860-kilogram) Boeing-built Port 5 truss segment. Port 5 is attached to the Port 4 truss element. P5 connects power and cooling lines, and serves as a spacer between the P4 photovoltaic module and P6 photovoltaic module. P6 will be joined to P5 during a later assembly mission. ■

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