Cathodes Delivered for Space Station Plasma Contactor System

The International Space Station's (ISS) power system is designed with high-voltage solar arrays that typically operate at output voltages of 140 to 160 volts (V). The ISS grounding scheme electrically ties the habitat modules, structure, and radiators to the negative tap of the solar arrays. Without some active charge control method, this electrical configuration and the plasma current balance would cause the habitat modules, structure, and radiators to float to voltages as large as -120 V with respect to the ambient space plasma.

With such large negative floating potentials, the ISS could have deleterious interactions with the space plasma. These interactions could include arcing through insulating surfaces and sputtering of conductive surfaces as ions are accelerated by the spacecraft plasma sheath. A plasma contactor system was baselined on the ISS to prevent arcing and sputtering. The sole requirement for the system is contained within a single directive (SSP 30000, paragraph 3.1.3.2.1.8): "The Space Station structure floating potential at all points on the Space Station shall be controlled to within ±40 V of the ionospheric plasma potential using a plasma contactor." NASA is developing this plasma contactor as part of the ISS electrical power system.

For ISS, efficient and rapid emission of high electron currents is required from the plasma contactor system under conditions of variable and uncertain current demand. A hollow cathode plasma source is well suited for this application and was, therefore, selected as the design approach for the station plasma contactor system. In addition to the plasma source, which is referred to as a hollow cathode assembly, or HCA, the plasma contactor system includes two other subsystems. These are the power electronics unit and the xenon gas feed system.

The Rocketdyne Division of Boeing North American is responsible for the design, fabrication, assembly, test, and integration of the plasma contactor system. Because of technical and schedule considerations, the NASA Lewis Research Center was asked to manufacture and deliver the engineering model, the qualification model, and the flight HCA units for the plasma contactor system as government furnished equipment. To date, multiple units have been built. One cathode has demonstrated approximately 28 000-hr lifetime, two development HCA units have demonstrated over 15 000-hr lifetime, and one HCA unit has demonstrated more than 38 000 ignitions. All eight flight HCA's have been manufactured, acceptance tested, and are ready for delivery to the flight contractor.

Flight-ready hollow cathode assembly units for the space station plasma contactor flight hardware (includes one qualification unit).

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