HIGH VOLTAGE POWER SUPPLIES FOR ITER EC AND IC SYSTEMS

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The RF Heating and Current Drive (H&CD) systems to be installed for the ITER fusion reactor are the Electron Cyclotron (EC), Ion Cyclotron (IC) and, although not in the first phase of the project, Lower Hybrid (LH). These systems require high voltage, high current Power Supplies (HVPS) in CW operation. These HVPS should deliver around 50 MW electrical power to each of the RF H&CD systems with stringent requirements in terms of accuracy, voltage ripple, response time, turn off time and fault energy. The PSM (Pulse Step Modulation) technology has recently demonstrated its ability to fulfill these requirements in other fusion reactors and has therefore been chosen for the IC and EC HVPS systems (see dedicated paper for the LH HVPS system development in this conference).

The PSM technology consists of several individual DC power sources called Switching Power Supply (SPS) modules that are connected in series in order to achieve the required high DC voltage. Each SPS module rectifies the voltage supplied from an individual secondary of a special multi-secondary transformer which converts the 22kV AC power from the ITER electrical distribution network into Low Voltage (LV) AC power and provides galvanic insulation between the modules. PSM power supplies have commonly been used in industrial broadcast transmitters for the last two decades but require however custom design effort to cope with the special requirements of the ITER H&CD systems.

India Domestic Agency (IN DA) is responsible for the Design and procurement of the IC HVPS system. The IC HVPS will supply the driver and end stages of the 9 RF sources of the IC H&CD system. Each RF source consists of two parallel amplifier chains with a combiner at the output; hence the choice of having 2 PSM based PS units per RF source. The IN DA and IO joint efforts of the last year have been focused on issuing the requirements for the IC HVPS system that are now included in the technical specification of the procurement arrangement. One HVPS unit has to provide up to 26kV / 170A / 2800kW to the RF source end stage and up to 18kV / 20A to the driver stage. This is achieved in the current reference design with 40 SPS modules with a tap feed connection for the driver stage. Functionality of the concept; single HVPS unit with dual separately controllable output, for end stage and driver stage need to be proved in India by R&D.

The EC HVPS system will supply up to 26 gyrotrons of the EC H&CD system and will be procured by IN DA and EU DA, both having equivalent specifications. The PSM based Main HVPS provides high voltage (typically 55 kV) high current (typically 90 A per pair of gyrotrons) electrical power with limited modulation capabilities (1 kHz) while the Body PS and Anode PS provide high voltage under limited current under but with high modulation capabilities (5 kHz). An ITER Task Agreement has been set up with EU DA in order to define the requirements and issue the technical specification for the Procurement Arrangement scheduled in 2011.

This paper describes the technical specifications, including interfaces, the resulting constraints on the design, and the conceptual design proposed for ITER EC and IC HVPS systems.