Contribution ID: **266** Type: **Oral**

THE POWER SUPPLY SYSTEM OF SPIDER

Tuesday 6 June 2017 16:20 (20 minutes)

Each ITER Heating Neutral Beam injector (HNB) is designed to deliver up to 16.5 MW of additional heating power to the plasma, by accelerating Deuterium or Hydrogen negative ions down to -1MV with a beam current as high as 40 A in D- or 46 A in H-, for as long as 3600 s.
The performance required to this HNB, in terms of energy, power and beam-on time, goes far beyond the limits that have been reached in the HNB realized so far and presents many outstanding technical challenges. For this reason, it was decided to realize a Neutral Beam Test Facility, called PRIMA, located in Padova, Italy, at the Consorzio RFX premises, including two experiments: MITICA, the full-scale prototype of the ITER HNB injector and SPIDER, the full-size Radio Frequency (RF) negative-ions source, with the aim to contribute to make more efficient and reliable the future operation in ITER.
This paper gives an overview of the SPIDER Power Supply (PS) system, made in collaboration among ITER Organization, Fusion for Energy and Indian Domestic Agency. It is a special system, which includes the Ion Source Power Supply (ISEPS) to feed the circuits for the generation and the extraction of the negative ions, and the Acceleration Grid Power Supply (AGPS) to provide the high voltage (-96 kV) for their acceleration. Among design issues, key ones were the high insulation voltage level and the necessity to manage as normal operation the grid breakdown, a frequent and unpredictable event equivalent to a short-circuit of the AGPS load.
The ISEPS is hosted in a large Faraday cage, (HVD, 13 m × 11 m × 5 m) air insulated for -100 kV to ground, supplied by a main insulating transformer. A High Voltage Transmission Line, based on an original air insulated tri-axial design, provides the power and signal connections from the PS to the Ion Source.
The ISEPS is characterized by a variety of power supplies, including four RF generators (1 MHz, 200 kW) to produce the plasma, one high voltage generator (12 kV, 140 A) to produce the required electric field between plasma and extraction grids, one high current generator (15 V, 5 kA) to produce suitable magnetic field components that reduce the extraction of electrons, and other power supplies. The AGPS is rated for 96 kV / 71A; it is based on pulse step modulation technology and includes three oil insulated multi-secondary transformers and 150 switching modules.
The procurement, including stand-alone tests, of the HVD and ISEPS has been successfully completed and the AGPS installation is nearing completion. Once testing of the AGPS is finished, the next commissioning phase will start, aiming to integrate the operation of all PS units under the central control and interlock systems.
The paper, after recalling key requirements and main issues of the SPIDER PS system, will present the most significant aspects of the subsystems design, manufacturing, and testing and will report on the progress of the realization giving some highlights from the recent installation and commissioning activities.

Eligible for student paper award?

No

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Session Classification: T.OP1: Power Supply Systems

Track Classification: Power supply systems