

Consorzio RFX Contribution to the JT-60SA Project in the Frame of the Broader Approach Agreement

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The JT-60SA satellite tokamak is now under advanced assembly phase in Naka (Japan). The majority of the new power supplies are provided by Europe, and the Italian National Research Council (CNR), acting through Consorzio RFX, has contributed in particular with two systems: the Quench Protection Circuits (QPC) for the superconducting magnets and the Power Supply System for RWM control.

The procurement of both the systems has been successfully carried out: the QPCs were delivered to Naka site in autumn 2014; the installation, commissioning and acceptance tests were completed in July 2015, fully in line with the schedule agreed in 2009. The protection system for the superconducting coils is composed of thirteen units: three for the TF circuit and ten for the PF circuits. Their duty is to conduct the coil current in normal operation and commutate it into a dump resistor in case of quench or other faults by means of a dc Circuit Breaker (CB). The nominal currents to be interrupted and the maximum reapplied voltages are 25.7 kA and 2.8 kV for the TF QPCs and ± 20 kA and ± 5 kV for PF QPCs.

As for the RWM-PS system, we are very close to the completion too, with the delivery on site and closure of the procurement expected in autumn 2018. This system consists in an input rectifier stage and 18 power amplifiers, one for each coils, capable to supply a peak current of 300 A and an output voltage of 240V and satisfy strict dynamic requirements in terms of latency and current bandwidth (50 μ s, 3 kHz) thanks to the adoption of new hybrid Silicon-Silicon Carbide (Si-SiC) power semiconductors for the power amplifiers and to the development of a new sophisticated control board, based on the combination of a fast microcontroller and a FPGA running optimized firmware.

A summary of the studies for the development of both the systems, of the main phases of their procurement and relevant results will be presented. The innovative aspects of their design will be highlighted: JT-60SA QPC represents the first application of hybrid mechanical-static technology for protection of superconducting magnets in fusion experiments and RWM-PS is the first PS system in fusion experiments adopting SiC semiconductors. The future work will be also discussed; outcomes from the operation of these systems, useful for ITER and DEMO, are expected.

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