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P4.089 Towards the completion of the Power Supply system for Resistive Wall Modes control in JT-60SA

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The Power Supply system for Resistive Wall Modes (RWM) control in the JT-60SA experiment is an Italian in-kind contribution to JT-60SA within the Broader Approach Agreement.

A very efficient control of RWM is necessary to access plasma currents with high β_N values (3-5) sustained for a hundred seconds, as foreseen in the JT-60SA research plan.

The development of the whole RWM control system (coils, power supplies and control) went through several steps of optimization; the final coil configuration consists in three toroidal rings of six coils placed on the plasma side of the stabilizing plate, inside the vacuum vessel; the coils are individually fed by dedicated power amplifiers, controlled in real time.

A key aspect highlighted by the physics studies was the need of a very fast reaction of the control system to prevent an excessive growth of the plasma instabilities and to limit the power required for their control. The main requirements for the power amplifiers were a peak current of 300 A, output voltage of 240 V, bandwidth of 3 kHz and a latency shorter than 50 μ s.

The fulfillment of such a fast dynamics was addressed via an R&D program which led to an innovative design solution adopting hybrid Silicon-Silicon Carbide (Si-SiC) semiconductor for the power amplifiers and to the development of a new sophisticated inverter on-board control.

The schedule of the procurement was finalized in 2015 and was articulated in a relatively longer phase, for the detailed design, prototype development and testing, in comparison with the manufacturing phase, due to the high level of innovation. The delivery to Japan is expected in September 2018. An overview of the main phases of the development and realization of this advanced system, the first in fusion experiments adopting SiC semiconductors, will be presented.

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