ENHANCEMENT OF THE POWER SUPPLY SYSTEMS IN RFX-MOD TOWARDS 2 MA PLASMA CURRENT

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RFX-mod is the largest Reversed Field Pinch experiment currently operating. During last years many improvements have been brought, both in Magneto Hydro Dynamic (MHD) control algorithms and start-up optimization[1], allowing to increase the RFX-mod maximum plasma current value in the range 1.7 – 1.9 MA with the maximum magnetizing current of 50kA. A further plasma current increase would be very useful for the present RFX-mod studies on enhanced confinement, but unfortunately with the present start-up the maximum available poloidal flux seems to be not sufficient to routinely and reliably reach higher plasma current, while the available toroidal flux largely exceeds the needs.

Thanks to the flexibility of the power supply system, composed of modular thyristor converters, a rearrangement of converters supplying poloidal and toroidal windings was studied, with the aim of obtaining the required poloidal flux variation for increasing the plasma current up to the nominal value of 2 MA.

The resulting Enhanced Poloidal Flux Capability scenario described in the paper allows a two-step plasma current ramp-up: in the first phase plasma current is formed and raised thanks to the poloidal flux swing resulting from the rapid current discharge of the magnetizing winding into the energy transfer resistance, as in the standard plasma shots, while in the second phase plasma current is further raised imposing a constant magnetizing winding current derivative. In this second phase the use of an increased number of thyristor converters feeding the poloidal circuit allows increasing the volt-seconds available to plasma and therefore permits reaching higher plasma current.

In order to increase as much as possible the plasma current obtainable also the first phase it is necessary to fully exploit the thyristor converters power capability. In the paper a detailed verification of their maximum performance is presented.

In addition to the enhancement of the poloidal circuit capability, the operation at very high plasma current requires an optimization of the MHD coil power supplies.

In fact the rise in plasma current leads to the increase of the current required from the radial field control inverters. Therefore a dedicated study of the inverter control system has been worked out, which allowed understanding how to increase as much as possible the output current without losing the inverter dynamic performance, so keeping the efficiency in the control of dominant and secondary modes, which is essential to obtain good and reproducible discharges.

[1] L. Zanotto, R. Cavazzana et al., “Optimization of the RFX-Mod performance at high current”. 36th EPS Conference on Plasma Phys. Sofia, June 29 - July 3, 2009 ECA Vol.33E, P-2.188 (2009)