RF HEATING OPTIMISATION ON TORE SUPRA USING FEEDBACK CONTROL OF INFRARED MEASUREMENTS (P2-C-197)

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Plasma Facing Components (PFCs) of modern fusion devices are submitted to large heat fluxes. Understanding and preventing overheating of these components during long pulse discharges is a crucial issue for next step tokamak ITER and future fusion reactors. Lower heat loads can be achieved by reducing the additional power resulting in a decrease of the plasma performance. So real time power optimisation is needed. Tore Supra, as a superconductor tokamak with water-cooled PFCs, is perfectly suited to tackle such a problem.

A real time infrared thermography diagnostics [1] has been implemented in Tore Supra as part of the CIMES project [2] allowing real time temperature monitoring of the most sensitive components. While the toroidal pumped limiter has been designed to sustain heat fluxes of 10 MW/m2 in steady state, the most critical points are ICRH heating antennae and LHCD launch-ers, where hot spots or overheating of large areas can be observed during high-injected power plasma discharges. The analysis of the heating processes identified the role of private power, cross interactions between antennas and launchers and formation of loose deposits.

Using the thermography diagnostics, a new feedback control has been implemented to pre-vent PFCs overheating. Before a shot, sensitive areas and associated temperature threshold are se-lected on the PFCs and physical interaction process is associated to each area (private power or cross interaction with other RF heating systems). During the shot, the central plasma controller unit decides whether the power has to be reduced and which RF heating system the reduction is applied on. RF power reduction is thus limited to the minimum necessary to preserve PFCs integrity. Thermography feedback control has been successfully used to detect and extinguish electric arcs on LHCD launchers too.

The infrared feedback control of PFCs temperature is a protection system, in the sense that it limits efficiently the PFCs temperature and a suitable tool for optimizing the RF plasma heating keeping the PFCs temperatures within their operational limits.

[1] D. Guilhem et al. QIRT journal, 2 N°1 p. 77 to 96 (2005)

[2] B. Beaumont et al. Fusion Engineering and Design, 56-57 667-672 (2001)