

Strategies for the plasma position and shape control in IGNITOR (P2-C-233)

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The control of the plasma position and shape is a crucial issue in IGNITOR as in every compact, high field, elongated tokamak. The capability of the Poloidal Field Coil system, as presently designed, to provide an effective vertical stabilization of the plasma has been investigated using the CREATE_L response model [1]. This linearized MHD model assumes an axisymmetric deformable plasma described by few global parameters.

An optimization of the vertical position control strategy has been carried out and the most effective coil combination has been selected to stabilize the plasma while fulfilling engineering constraints on the coils and minimizing the required power and voltage. The two pairs of coils selected for the vertical control will be fed up with up-down anti-symmetric currents provided by a dedicated supply and overlapped to the scenario currents. The growth rate of the vertical instability and the power required by the active stabilization system have been estimated with this model, indicating that it is possible to design a control system able to guarantee a stability region that includes the most interesting operation conditions.

An assessment of the requirements for the plasma cross section shape control has been carried out considering independent perturbations of the plasma global parameters as disturbances and showing that the undesired shape modification rejection is possible with the present PFC and power supply system. The PF coils have been ranked with respect to their capability to restore the shape modifications due to different plasma disturbances and the most effective coil combination, that minimizes recovery time and voltage required, has been selected.

In order to have additional means to monitor and control the centre of the plasma column, under demanding conditions, through the plasma X-ray emission, appropriate Gas Electron Multiplier detectors are being developed and their capability to reconstruct the plasma position has been preliminarily investigated.

[1] R. Albanese, F. Villone, "The Linearized CREATE_L Plasma Response Model for the Control of Current, Position and Shape in Tokamaks", Nucl. Fus., vol. 38, p. 723 (1998)