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ITR/P5-29: Error Fields Expected in ITER and their Correction

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This paper summarises the present status in the study of error fields expected in ITER (n = 1 modes) and their correction. Two approaches were used in the study of ITER error fields: analysis of the "3-mode"error fields and analysis of the "overlap"error fields. Since the earliest phase of the ITER design activity, the "3-mode"error field criterion on the weighted averaged amplitude of the (1,1), (2,1) and (3,1) Fourier modes of the component of magnetic field normal to the q = 2 surface has been used to determine the allowable level of error fields. The newly developed criteria on "overlap"error fields and algorithm for calculation of the "overlap"error field has been derived from analysis performed with the IPEC code for three fiducial ITER plasmas. The IPEC code calculates those components of the external error fields which are most efficient at driving the growth of a magnetic island, taking into account the perturbation to the plasma equilibrium associated with the external fields.

Error fields expected in ITER from different souses are analyses: a) the main contributor to the error fields - misalignments of TF, CS and PF coils, b) TF, CS and PF coils joints and busbars, c) ferromagnetic structures of the six test blanket modules, d) irregularity of the ferromagnetic inserts located near NBI ports and scattering in the values of the steel plate thicknesses and saturated magnetization, e) magnetic field reduction system of NBIs, f) ferromagnetic elements of the bioshield and tokamak complex (rebar in concrete), g) scattering in weak magnetic permeability of the austenitic steel from which the cryostat, the cryostat thermal shield and the vacuum vessel thermal shield are made.

The main actuator for error field correction in ITER is the correction coils (CC). The analysis performed has shown that CC are capable to reduce the expected error fields below the present criteria. The primary objective of the ELM coils is the control of Edge Localized Modes with the goal of avoiding excessive heat loads on the plasma facing components of the tokamak. However, in combination with CC, ELM coils can be used in some experiments for identification of the error fields and for study of how they should be reduced. Capability of ELM coils to correct error fields has been analyzed.

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