THE MAGNET SYSTEM OF ITER AND THE ERROR FIELDS

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Error fields in Tokamaks are small departures of the exact axisymmetry of the ideal magnetic field configuration. Their reduction beyond a threshold value by the error field correction coils is essential since sufficiently large static error fields lead to discharge disruption. The error fields are originated not only by coils fabrication and installation alignment tolerances, joints and busbars but also due to the presence of ferromagnetic elements.

The start of plasma current flattop with relatively low plasma density is considered as a critical state of the 15 MA scenario for the onset of locked modes causing disruptions. A figure of merit $B_{3\text{-mode}}$ based on the lowest error field harmonics [(1,1); (2,1); (3,1)] was chosen to assess the error fields expected in ITER.

Analysis performed last years in an independent way by CREATE (EU) and ENERGOPUL (RF) groups has allowed a deep understanding of the error fields induced by all the possible sources. Both groups were successfully benchmarked with the estimation of the error fields induced by a given deformed shape of a TF coil obtaining a perfect match of the results up to 2 orders of magnitude smaller than the defined threshold of $B_{3\text{-mode}}/B_o < 5\times10^{-5}$.

Three different sets of independent variables based on a 3D rigid body movement of the coils have been provided for the 6 CS modules, 18 TF coils and 6 PF coils tolerances, which have allowed a clear understanding of the weight of each of the variables in the induced error fields. The results obtained in 2008 with a realistic set of magnets tolerances concluded that the system of correction coils provides effective suppression of the error fields with margin to correct possible impact of other sources. In particular, it has been shown that superconducting joints, feeders and busbars play a secondary effect; however the radial position of the TF coils and the tilt and radial shift of the CS stack would have a relevant influence. The ensuing recent sets of variables studied aimed at deepening in the understanding of the operational limits.

The present paper summarizes the conclusive results obtained by both benchmarked teams, the possible impact in the coils fabrication and installation that these results may have as well as the future planned assessment of error fields in magnetic configuration other than that at the start of current flattop in 15MA scenario.