SPECIFICATION OF ASYMMETRIC VDE LOADS OF THE ITER TOKAMAK

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Two phenomena that were identified as the cause of asymmetric loads on tokamak components have been observed at existing tokamak machines during asymmetric vertical displacement events (AVDEs), in particular at JET. The conservative specifications of the expected characteristics of both phenomena in ITER as well as the consequent asymmetric loads are summarized here. The related loads are specified for AVDEs of different load categories II, III and IV.

The first observed phenomenon is a non uniform plasma toroidal current along the toroidal coordinate observed in plasma kink instabilities. The identified reason for this is that part of the plasma halo current that flows, mainly toroidally, in the passive structure, see [1]. This electrical current causes significant asymmetric electromagnetic (EM) loads on the tokamak components, i.e. the vessel and in-vessel components and the magnetic coils. The evaluation of the tokamak components asymmetric loads is based on a model describing the asymmetric currents that is defined as the sink and source model and is described in [1]. The specification of the related asymmetric loads for the ITER tokamak was derived in a three-step approach:

1) In the first step the extrapolation of the observed plasma asymmetries to ITER is made (mainly based on JET experimental data). As a result the asymmetric plasma halo current is specified that flows mainly in toroidal direction in the passive structure (→ asymmetry current in the sink and source model dI_p).
2) In the second step EM analyses are performed based on the specification of the asymmetry current to calculate the consequent loads that - based on the sink and source model - act on the ITER tokamak components.
3) In the third step the sideways forces and tilting moments acting on the ITER tokamak components are specified based on the results of the EM analyses.

The second observed phenomenon is a toroidal peak of the poloidal halo current that flows in the passive structure to stabilize the vertically displaced plasma. This poloidal halo current causes asymmetric vertical loads on the passive structures and the toroidal magnetic coils. The specification of the related loads is based on experimental data from the most important existing tokamaks.

[1] V. Riccardo, P. Noll, S.P. Walker: Forces between plasma, vessel and TF coils during AVDEs at JET, IAEA, 2000