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Electromagnetic Analysis of DTT Central Solenoid and Poloidal Field coils

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The magnetic system comprising all the superconducting poloidal coils is an important part of the Divertor Tokamak Test facility (DTT). It is composed of several parts mutually coupled among them: six Central Solenoid (CS) modules, six Poloidal Field (PF) coils, the passive structures and the plasma. This implies that a current variation in any poloidal coil can cause a significant current or voltage variation in the others, as well as a change of the plasma current. In particular, during a fast plasma disruption the magnetic flux in the tokamak changes rapidly, which in most cases will cause high-voltage and/or over-current across each CS and PF coil and may bring severe damage to the components. Therefore, to investigate the transient voltage and current waveforms excitations occurring on the terminals of the superconducting coils, an electrical model including poloidal coils (CS and PF), vacuum vessel (VV) structure, stabilizing plates and the plasma, has been described and presented.
In order to calculate the mutual inductance matrix of the poloidal coils and passive structures, a Finite Element Method (FEM) was used. Then, the matrix was implemented in the lumped model including the power converters, the crowbar, the Switching Network Units (SNU), bus bars and feeders. Different initial conditions were considered for electromagnetic analysis and a wide survey of possible scenarious was simulated: breakdown, fast plasma disruption and so on

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