High voltage investigations for ITER coils (P1-E-163)

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The superconducting ITER magnets will be excited with high voltage during operation and fast discharge. Because the coils are complex systems the internal voltage distribution can differ to a large extent from the ideal linear voltage distribution. In case of fast excitations internal voltages between conductor and radial plate of a TF coil can be even higher than the terminal voltage of 3.5 kV to ground which appears during a fast discharge without a fault. Hence the determination of the transient voltage distribution is important for a proper insulation co-ordination and will provide a necessary basis for the verification of the individual insulation design and the choice of test voltages and waveforms. Especially the extent of internal overvoltages in case of failures, e. g. malfunction of discharge units and / or arcing is of special interest.

Transient calculations for the ITER TF coil system have been performed for fast discharge and fault scenarios to define test voltages for ITER TF. The conductor and radial plate insulation of the ITER TF Model Coil were exposed at room temperature to test voltages derived from the results from these calculations. Breakdown appeared during the highest AC voltage step.

A fault scenario for the TF fast discharge system is presented where one fault triggers a second fault, leading to considerable voltage stress.

In addition a FEM model of Poloidal Field Coil 3 for the determination of the parameters of a detailed network model is presented in order to prepare detailed investigations of the transient voltage behaviour of the PF coils.