ELECTROMAGNETIC TRANSIENT SIMULATION USING A SHELL APPROACH FOR ITER CXRS UPPER PORT PLUG DUE TO PLASMA VERTICAL DISPLACEMENT EVENTS

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Transient electromagnetic (EM) analysis focusing on main components of the ITER core charge exchange recombination spectroscopy (core CXRS) Port Plug being developed by Forschungszentrum Jülich (FZJ), ITER-NL and UKAEA(CCFE) is presented. The CXRS primary function is to transfer the light in a visible part of spectra emitted by interaction of the plasma ions with a diagnostic neutral beam.
The TYPHOON software package has been used for the EM analysis. The code is dedicated for simulation of transient electromagnetic processes using a shell approach in an integral-differential formulation to model thin conducting multi-connected shells, arbitrary located in a space. The advantage of the shell approach is higher flexibility in modelling detailed structures compared with widely used 3D models. On the other hand, shell approach requires ultimate care in modelling relatively thick structures. These issues are discussed in the paper.
Two vertical displacement events (VDE) seemed to result in the largest EM loads on the main CXRS components were agreed with FZJ and have been modeled. Transient electromagnetic processes caused by different sources have been considered separately, and then superimposed to obtain total solution. Three types of transient processes for each type of VDE have been analyzed: 1) due to variations of a toroidal plasma current, shape and position and due to variation of poloidal field coils currents, 2) due to variations of a toroidal magnetic flux and 3) due to variations of the Halo current. The analysis covers two options of electrical contact between the Outer Shell of the Port Plug and the blanket shield module (BSM).
The results are ready for benchmarking with two others independent 3D EM models developed for the upper Port Plug. The way of transferring calculated EM loads to the 3D structural models is discussed. Further sub-modeling for consideration of EM loading on separate elements of the complex mechanical CXRS structure is considered.