STATUS OF THE EU DA ELECTROMAGNETIC ANALYSIS CONTRIBUTION TO ITER

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Fusion for energy (F4E), the European Domestic Agency for ITER, is involved in a relevant number of activities in the area of electromagnetic analysis in support of ITER general design, and of specific requirement of the EU in-kind procurement support. The F4E Analysis and Codes group carries out part of those tasks "in-house", and subcontracts other activities to qualified companies, keeping for itself key functions like liaison with IO, scheduling, technical coordination and monitoring. To this last purpose, on May 2009 the open procedure Service Framework Contract for the Provision of Engineering Support in the area of electromagnetic Analysis has been signed to provide support in the electromechanical analysis of ITER components, DC and AC Electromagnetic analysis of super-conducting magnets, error field electromagnetic analysis. Several task orders have been sent to the awarded company and the corresponding specific contracts have been signed, some of them have already been closed. This paper aims at describing the different activities, highlighting the main assumptions, objectives and, when available, results and conclusions.

The core business of our group is linked with the electromechanical analysis of several ITER components (glow discharge conditioning and in-vessel viewing system, blanket shield modules and first wall panels, blanket cooling manifolds, TBM port plug, etc.) subjected to disruptive events of the plasma. The eddy currents produced by the magnetic flux variation interact with the magnetic field and produce forces and torques which have to be assessed to evaluate the structural integrity of each one of those components.

Another important activity is related to the quench detection of the ITER TF coils. The detection of a quench for the sake of magnet protection is a challenging (as well as of utmost importance) operation due to the presence of external magnetic fields linking differently the TF conductor. In fact, in order to detect a transition of the superconductor to a normal conducting state the removal of the inductive component of the voltage along the cables is required. To this purpose within the ITER baseline the following two redundant systems are foreseen: i) bridges schemes with central points at He inlets between half double pancakes, ii) compensated signals by using co-wound tape. The assessment of both systems can only be done by analyses, which consider the overall list of players, including plasma and passive structures as well as effects from other magnet systems.

Last, but not least, another activity is on going on the error field analysis due to tolerances in both construction and assembly of ITER magnets. The magnetic error fields (i.e. the toroidal and poloidal harmonic components that exist as a result of imperfections in the magnet fabrication and positioning) have a critical impact on the plasma confinement in ITER and must be strictly controlled. The coil manufacturing and final installation tolerances contribute in a complex way to the error fields. The combination of tight manufacturing and installation procedures with the flux induced by the pulsed correction coils will allow the compensation of the lower harmonics of the plasma electromagnetic field. In this context also several magnetostatic analyses have been performed with the purpose to reduce the ripple at the plasma separatrix during plasma discharge (from the initial value of 1.2%) to the prescribed value (about 0.4%).