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Electromagnetic modelling and design of DEMO and disruption location prediction

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The design study of a DEMOnstration (DEMO) Fusion Plant is one of the main points of the European Roadmap to Fusion Electricity [F. Romanelli, http://www.efda.org/wpcms/wp-content/uploads/2013/01/JG12.356-web.pdf]. The pre-conceptual design phase of DEMO is presently used to explore a flexible range of the main machine geometrical design parameters, including machine magnetic configurations, and optimisation of plasma scenarios and conductive geometries.
In this paper is presented the electromagnetic modelling of the DEMO baseline scenario, including the analysis and design activities on the plasma surrounding electrically conductive structures, and their influence on the passive vertical stabilisation (VS), which is a machine size driver, due to the large amount of power needed to vertically stabilise the plasma, and the limitations on the poloidal field coils. A careful design of the blanket first wall poloidal geometry was performed, taking into account the plasma heat load on the wall, allowing the minimisation of the distance between the plasma and the vacuum vessel, which is the closest electrically conductive toroidally continues structure . Both the improvements on the passive and active [R.Ambrosino, this conference] VS allowed to increase the maximum controllable plasma elongation at 95% of the separatrix, from 1.59 to 1.65, from the previous to the most recent DEMO baseline, corresponding to an increase on fusion performances.
Finally a study was carried out on the possibility to predict the plasma final position, following a vertical displacement event, which is essential for a DEMO wall protection strategy from plasma transients. Such point is located where the field after disruption is tangential to the FW and pushing the plasma onto it, under the assumptions that the current quench time is faster than the L/R time constant of the passive structures. The final position was also verified using dynamic simulations and images from JET fast camera during a VDE.

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