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P4.032 Electromagnetic analyses of Single and Double Null configurations in DEMO device

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The development of a conceptual design for a demonstration fusion power plant (DEMO) is a key priority of the recent European fusion program. The DEMO design faces an even higher challenge taking into account that, compared to ITER, the European DEMO design has a fusion power that is four times higher and a major radius that is only 1.5 times larger than ITER. From a first review of the wall loads and the associated limits in DEMO, the power load on the Plasma Facing Components (PFCs) associated to the single null configuration clearly underlines a significant challenge that requires substantial engineering efforts as well as the possibility to explore alternative divertor concepts.

In this paper the exploration of double null configurations in DEMO is proposed. Indeed, a comparative electromagnetic analysis of single and double null configurations is performed in terms of vertical stability (VS) and disruptions. VS properties and disruptive events are highly relevant for the protection of the PFCs and they also determine the maximum tolerable elongation of the plasma, to which the performance of the device has an extreme sensitivity for fixed major radius.

The comparison of SN and DN configurations is not simple and it also requires that the machine design is optimized to a comparable level. As the DEMO SN baseline design is largely based on ITER and hence already optimized in terms of vertical stability, special attention has been given to reducing the distance between toroidal conducting structures and plasma in DN. The assessment of the VS performance is done in the 2D axisymmetric case in terms of best achievable performance assuming a constant voltage on the vertical stabilization system. The disruptive events are analyzed in the 3D case to take into account the non-axisymmetric effects related to port locations and non-toroidally continuous structures.

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