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Electromagnetic and mechanical analysis of alternative magnetic divertor configurations for DEMO

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The development of a reliable solution for the power and particle exhaust in a reactor is recognized as a major challenge towards the realization of DEMO [1]. Alternative magnetic configurations such as Double Null, Snowflake, X and Super-X divertors are considered as a promising solution to reduce the heat load on the divertor targets even if their scalability on a DEMO size device is a challenging engineering problem.
The definition of an alternative magnetic configuration requires an optimization of the machine geometry, from the plasma facing components to the divertor structures; dedicated solution for the toroidal and poloidal coil systems are also needed to reduce the vertical forces and mechanical stresses on the active structures. Additional engineering limitations are related to remote maintenance and the plasma controllability of the alternative divertor concepts.
In this paper, starting from the results in [2], an electromagnetic and mechanical analysis of DEMO alternative configurations in presented. The controllability of the plasma configuration is tackled in terms of plasma vertical stability and shape sensitivity respect to a prescribed set of disturbances. Finally, the possibility to increase the range of alternative divertor concept considering also double null alternative divertor concepts is investigated assuming the presence of in-vessel divertor coils with a current limitation to 1MAturns.

[1] Fusion Electricity –A roadmap to the realisation of fusion energy, November 2012 (http://users.euro-fusion.org/iterphysicswiki/images/9/9b/EFDA_Fusion_R oadmap_2M8JBG_v1_0.pdf)
[2] R. Ambrosino, A. Castaldo, S. Ha, V.P. Loschiavo, S. Merriman, H. Reimerdes, Evaluation of feasibility and costs of alternative magnetic divertor configurations for DEMO, Fusion Engineering and Design, 2019.

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