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P2.027 Equatorial electron cyclotron port plug neutronic analyses for the EU DEMO

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Within the Power Plant Physics and Technology (PPPT) programme in the EUROfusion Consortium design activities are currently in progress for the development of a DEMOnstration Fusion Power Plant (DEMO). In this framework, the design of the machine and the integration of in-vessel components require neutronics analyses fundamental to verify the tritium self-sufficiency, the shielding requirements and the structural integrity of its components. In particular, the penetrations in the blanket and in equatorial port plug introduced by the electron cyclotron (EC) heating system, namely due to openings for the antenna waveguides, can lead to significant leakage of neutrons which may increase the nuclear loads of the superconducting toroidal field (TF) coils and material damages in the vacuum vessel (VV) beyond design limits as well as reduce the tritium breeding capability. In this study a three-dimensional MCNP calculations were conducted for the preconceptual designs of the EC port plugs and shielding optimisation were performed in order to ensure that the DEMO design limits are not exceeded.
Two configurations of the EC heating system both featuring 8 square 63.5 mm × 63.5 mm waveguides (WGs) arranged in two horizontal stacks or a single vertical stack were analysed and shielding solutions for EC port plug proposed. In the first configuration the main focus was on the nuclear heating of the TF coils and in the second case the neutron induced damage of the VV. Analyses were performed using a DEMO Water Cooled Lithium Lead (WCLL) with integrated EC configurations model of a half of the sector (i.e. 10° model) and relevant ones repeated with a full sector model (i.e. 20° model) to test the reliability of results. Additionally, the effect of the radiation on the WGs closest to the plasma was analysed as well as the impact on Tritium Breeding Ratio.

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