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P4.145 Neutronics Studies for Horizontal Lower Port Option in DEMO

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The conceptual design activity of the Demonstration Fusion Power Reactor (DEMO) is in progress in the Power Plant Physics and Technology (PPPT) programme within the EUROfusion Consortium. In this work neutronics studies, fundamental for the nuclear design of DEMO, are presented for the horizontal lower port, an optional concept that is currently under investigation. Two possible configurations of the horizontal lower ports have been analysed: the vacuum pumping port, with the pumps located inside the port, and an empty port designed for remote handling. For both configurations three-dimensional Monte Carlo calculations have been performed with MCNP5 in a DEMO Water Cooled Lithium Lead (WCLL) model based on 2017 reactor configuration to assess the neutron flux inside and around the port and the nuclear heating in sensitive components, such as the toroidal field coil (TFC) conductor, the vacuum pump, the port walls and the port closure plate. Different shielding configurations have been considered, by adding shielding blocks at the horizontal lower port entrance. Single and double wall port walls and closure plates with different thickness have been studied to reduce nuclear loads and neutron flux. The shielding solutions provide sensible mitigation of nuclear loads in lower port area. However, the nuclear heating on the TFC exceed the limit of 50 W/m³, mainly due to the radiation streaming through the large divertor pumping duct caused by the lack of shielding liner in DEMO baseline 2017 model assumed in these analyses. Design optimization strategy with divertor liner, reduction of pumping duct opening and additional shielding in lower port are needed to reduce the nuclear loads on TF coil.

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