Neutronic analyses for the shielding design of the DTT Neutral Beam Injector Transmission Line

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The Divertor Tokamak Test (DTT) is a new experimental facility designed to the study of plasma exhaust issues in a DEMO-relevant environment and to test different divertor configurations. During high-performance operation, DTT is expected to produce approximately 1.5×10^{17} neutrons per second from D-D fusion reactions. In addition to that a non-negligible amount of neutrons produced from D-T reactions are also expected, due to the triton burn up. The building that will host the DTT device must provide adequate radiation shielding to protect both workers and the public from neutron and gamma radiation.
A three-dimensional (3D) neutronic analysis has been performed to evaluate the effective dose rates in areas outside the main penetrations of the north wall of the Torus Hall Building (THB). Among these cut-outs, the Neutral Beam Injector (NBI) Transmission Line (TL) features an opening of about 2.3 m in diameter is foreseen, through which a significant amount of neutron and gamma radiation escape from the THB, causing an increase of the effective dose rate to the workers and the public.
This work therefore focuses on assessing the neutron and gamma streaming through the NBI TL penetration, with the aim of optimizing and evaluating the effectiveness of several proposed shielding solutions to ensure adequate worker protection in terms of occupational dose.
Neutron and gamma transport simulations were carried out with the MCNP5 Monte Carlo code employing variance reduction techniques (i.e. weight windows) generated with the Global Variance Reduction (GVR) tool.
Results of the analyses are presented and reported along with some considerations to improve the shielding capabilities.

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