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Plasma and Neutral Beam Injector Guard Wall interaction using MCNP6 and GEANT4

Assessing the amount, type, and energy of radiation encountered requires knowledge of the radiation source and the shielding effect of the type of material between the radiation source and the area of interest.
The choice of elements in structural materials such as stainless steel can reduce the radiation levels due to particle activation. The dose rate to workers and electrical components is managed from the material used for radiation shielding. This work analyzes candidate materials used in the ITER neutral beam duct. Quantitative analysis of radiation effects in the Neutral Beam Injection (NBI) section closest to the ITER plasma region was carried out using GEANT4 and MCNP6 simulation.
The materials analyzed include ferritic martensitic (F-M) steels at different chromium compositions (9-25 wt %), bainitic (Fe-3Cr-3W), 316L ITER grade stainless steel, nickel-based alloy 1 (Ni-25Cr-20Fe-12.5W, 0.05C), SS nickel-based alloy 2 (Ni-23Cr-18W-0.2C), 316L ITER grade, and 304B4 stainless steel. GEANT4 and MCNP6 input geometry was developed based on concentric finite cylinders along a common axis of the neutral beam duct. Included in the ITER geometry are the plasma region, outboard blanket and shield, a neutral beam injection (NBI) port with a stainless steel-water layered beam guard, mid-plane port walls, an adjacent toroidal field coil, cryostat, and biological shield.
GEANT4 and MCNP6 simulations were used to determine plasma interaction in the heating neutral beam duct closest to the ITER toroidal plasma region.
Key words: Cryostat, GEANT4, ITER, MCNP5, neutral beam injection, plasma, toroidal.

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