## *ABSTRACT*

*Tokamak-type nuclear fusion reactors face challenges associated with neutron irradiation, which can activate structural materials and render them radioactive. This study aims to compare the neutron activation characteristics and shielding effectiveness of Stainless Steel (SS) 304L and SS 316L used as vacuum chamber wall (VCW) materials in the ASDEX Upgrade tokamak model using the MCNP6 simulation code. The neutron source was defined as a deuterium–deuterium (D–D) fusion reaction with an energy of 2.45 MeV and a production rate of 1 × $10^{16}$ neutrons per second. The VCW thicknesses analyzed were 2 cm, 4 cm, and 8 cm. The investigated parameters included neutron flux distribution, neutron current, activation reaction rate, and shielding effectiveness. The simulation results showed that SS 304L and SS 316L exhibit nearly identical neutron flux distributions and shielding performance, with differences of less than 0,3% across all analyzed scenarios. Increasing the VCW thickness resulted in higher material activation rates due to the increased probability of neutron interactions within the material. The dominant activation reaction in both materials was $^{54}Fe(n,p)^{54}Mn$, whereas SS 316L exhibited additional significant activation through the $^{98}Mo(n,\gamma)^{99}Mo$ reaction due to the presence of molybdenum. The activation rate of Mo in SS 316L exceeded the combined contribution of other activation reactions for all investigated thicknesses. The results indicate that material type has a relatively minor influence on shielding effectiveness compared with VCW thickness. Although both materials provide comparable shielding performance, SS 304L produces lower activation levels because it does not contain molybdenum. Furthermore, increasing the VCW thickness introduces a trade-off between shielding effectiveness and material activation that must be considered in the design of structural components for fusion reactors.*



***Keywords**: MCNP6, neutron activation, shielding, SS 304L, SS 316L*