

# Nuclear analysis and assessment of irradiation effects on the Divertor Plasma Facing Components of the DEMO fusion reactor

The Plasma Facing Components (PFCs) of the divertor target contribute to the crucial functions of the divertor such as heat removal and particle exhaust during fusion operation. They are subjected to a very harsh and complex loading environment characterized by intense particle bombardment, high heat fluxes (HHF), fast neutron irradiation, varying stresses and impact loads. In particular way this study is fully devoted to the comprehension of the neutron irradiation impact on the DEMO divertor PFCs performance (lifetime, potential failures phenomena, main critical issues and concerns), which represents one of the main issues still with many pending questions. The achievement of this purpose has required the performing of a detailed neutronics and activation analyses carried out for the first time so thoroughly, followed by a thermo-structural integrity assessment based on the structural design rules defined in the Inelastic Analysis Procedure (IAP) methodology. A first element of novelty of this study, lies in the evaluation of the synergetic effects of high thermo-mechanical loads and intense neutron irradiation expected on the main plasma facing materials (W, Cu/CuCrZr). Three-dimensional neutronics analyses have been performed with the MCNP5 Monte Carlo code and the recommended JEFF 3.3 nuclear data libraries, activation analyses have been performed by means of FISPACT-II inventory code and TENDL 2015 nuclear data libraries. The thermo-structural analyses have been carried-out by means of ANSYS Mechanical. The main critical issues which affect the PFCs performance and lifetime are the strong embrittlement of Cu/CuCrZr and W, as well as the low cycle fatigue duration.