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#03-251 Long Term Neutron Activation in JET DD Operation

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The Joint European Torus (JET) is the largest operating fusion tokamak in the world. This allows performance of unique experiments that cannot be performed anywhere else. One such experiment is long term irradiation of different fusion relevant materials with neutrons produced in deuterium-deuterium (DD) and deuterium-tritium (DT) plasmas. During the last DD plasma campaign at JET in 2019 and 2020 several different ITER relevant materials and activation foils were irradiated in a specially design long-term irradiation station located inside the vacuum vessel with the purpose of testing activation of ITER materials by fusion neutrons. The samples were exposed to neutron fluence of 1.9×10^{14} n/cm^2 during JET discharges performed in the experimental campaign over a period of 5 months. After the irradiation with DD neutrons, activation of materials was determined with measurements of long-lived isotopes in the samples such as Co-58, Co-60, Fe-59, etc.

In order to support the long-term irradiation experiments at JET a series of Monte Carlo neutron transport calculations is required to calculate neutron fluxes, neutron flux spectrum, reaction rates, etc. A detailed computational model of the complex JET tokamak structure and the experimental position was developed in MCNP code and validated on experiments previously performed at JET. Another important parameter for computational analysis is the detailed description of the materials in the JET structure and activation samples. The detailed material composition together with the nuclear data libraries is used to properly describe physics of neutron interaction with materials during Monte Carlo simulations. The last important parameter for the Monte Carlo simulation is the source of neutrons. In DD plasma some DT reaction take place due to production of tritium during the DD reaction. Due to this the fraction of neutrons produced by DT reaction is of significant importance in computational analysis.

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