Neutronic analysis for the IFMIF EVEDA Reference Test Cell and Test Facility

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The IFMIF (International Fusion Material Irradiation Facility) project is in the so-called EVEDA phase aiming at producing a detailed and fully integrated engineering design under the framework of the Broader Approach activity. The Test Facility (TF) consists of several subsystems including the test cell (TC), which is the central part of IFMIF where an intensive neutron field is generated by d-Li nuclear reactions to irradiate candidate fusion reactor materials placed inside the test modules (TMs). During the EVEDA phase an optimized TC design has been proposed, developed and considered as the reference TC. In the present paper the details of the neutronic analyses to support the design work of TC as well as TF are described.

A very detailed geometrical model for neutronic analyses has been prepared directly from engineering CAD data by utilizing the McCad conversion software developed at KIT. The geometrical model includes the detailed descriptions for the lithium target system proposed by Japan, three test modules, and the 3-dimesional arrangement of the biological shielding based on the reference TC design. The Monte Carlo code McDeLicious, which is an enhancement to MCNP5, has been utilized in order to adequately simulate the neutron and photon productions from the ^{6,7}Li(d,xn) reactions in the lithium target. The present analysis is focusing on the following items which are important for the TF engineering design: the biological dose distribution around TC during operation, the nuclear heating distribution inside the biological shielding, and the nuclear property of the TC liner, in particular the He production rate that influences the possibility of welding in maintenance works of the liner. Some countermeasures for reducing the He production are also discussed.