

Neutronics Experiment for Design Validation of Indian TBM Shield Module

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The testing of the breeding blanket systems is one of the vital objectives of the ITER. It will generate the significant information for DEMO fusion reactor. ITER has assigned the three equatorial ports for testing of six blanket systems. In those six, there is a Test Blanket System (TBS) of India which is Lead Lithium Ceramic Breeder (LLCB) blanket system and it will be integrated into one-half of ITER equatorial port#2. Being a part of ITER, TBS has to follow all safety & design guidelines of ITER. In order to follow the safety guideline of radiation dose limits in ITER ports inter-spaces, a shield module, made of stainless steel and water channels, is associated with Test Blanket Module (TBM) to limit the direct radiations in port inter-space areas. The conceptual design of Indian TBM shield module has been assessed by neutronic simulation using MCNP. The shield module is having the classification of radiation protection important component due to the function of radiation exposure control which leads to ensure the design of the component. A neutronic experiment is designed and performed to validate & verify the design of shield module. The design of the experiment is made by considering the two references; one is the neutron spectra on the front surface of TBM shield under ITER environment and second is the neutron attenuation in shield module under ITER conditions. The experiment is designed considering the irradiation of mock-up under 14 MeV neutron source facility of IPR. The neutron source is having the yield of 1010 n/s. The neutron spectra of the front surface of the shield mock-up have been optimized to achieve the reference spectra of TBM shield module. The neutron spectra & flux are measured using the activation foils detectors. The C/E ratio is obtained from the comparison of measured & simulated neutronic responses. The neutronic simulation is performed using MCNP5 and FENDL 2.1 cross section data. The unfolding code SAND-II-SNL is employed to obtain the neutron spectra from activation foil measurements. This experiment will also support in preparation of neutron spectra measurement for Indian TBM system and improvement of nuclear simulations. The paper will cover the detailed neutronic design, details of irradiation, neutron spectra measurements and outcome of the experiment.

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