TEST FACILITY FOR A NEUTRON FLUX SPECTROMETER SYSTEM BASED ON THE FOIL ACTIVATION TECHNIQUE FOR NEUTRONICS EXPERIMENTS WITH THE ITER TBM

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Several types of Test Blanket Modules (TBM) will be installed in ITER with the objective, among others, to conduct performance tests and check the prediction capability of the applied simulation codes in different areas. An important aim of the neutronics TBM experiments will be to check the prediction accuracy of nuclear responses in an environment closer to a future fusion reactor than so far provided with existing facilities. Quantities to be measured and checked are for example spectral neutron fluxes and tritium production rates.

There are currently only a few measurement methods available which are compatible with the harsh environment conditions such as high temperatures, strong EM fields and intensive ionizing radiation in the TBM during operation. A "traditional" but promising methodology to gain information about the spectral neutron fluence is based on activation foils with well-known activation cross sections. However, since the TBM will be installed for a long time in ITER without the possibility of access between plasma pulses or even experimental campaigns, it will be necessary to transport the activation foils by a pneumatic sample changer into the TBM. Such a transport system would allow also for measurement cycles shorter than a plasma pulse in order to obtain a temporal neutron flux profile.

KIT, in cooperation with Technical University of Dresden (TUD), is developing a demonstration measurement system with the goal to allow automated measurements of time profiles of spectral neutron fluxes by means of activation foil packages. The system is currently being installed at the neutron laboratory of TUD. In the current state, irradiation in the TBM is simulated with the intensive DT neutron generator of TUD and a high-purity Ge-Detector for collecting the gamma-ray spectra of the activated foil packages. The test facility is flexible to explore also other types of gamma-ray detectors such as CdTe or CZT in future investigations which might be found better suited for the final system to be used with the TBM.

We will present possible activation foil combinations tailored for anticipated measurement regimes. We will also point out deficiencies in the nuclear cross section data of candidate activation reactions of foil materials which are not included in the "traditional" activation foil canon but which would be very suitable for the anticipated measurement regimes in terms of half-lives and gamma-ray emission characteristics in order to reduce the uncertainty of the flux measurement.