STUDY ON THE RESPONSE OF IFMIF FISSION CHAMBERS TO MIXED NEUTRON-GAMMA FIELDS: PH-2 EXPERIMENTAL TESTS

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The engineering design of fission chambers as on-line radiation detectors for the International Fusion Materials Irradiation Facility (IFMIF) is being performed in the framework of the IFMIF-EVEDA tasks. As part of the CIEMAT work, a study on the detectors specifications as well as on the feasibility of the diagnostic to monitor the spatial profile of the IFMIF neutron flux was performed [1]. As a result, a detector with a diameter of 3 mm and ^{238}U as fissile deposit was found to be the most adequate for working in the IFMIF High Flux Test Module (HFTM).

The validation activities in support of the results of the study can be divided into three different phases: Phase_1 for studying the detectors behavior under an environment free of neutrons; Phase_2 for monitoring fast neutron fluxes; and Phase_3 for testing the robustness of the detectors. The tests of Phase_1 were performed at CIEMAT with two CFUR43 PHOTONIS detectors (one fission and one ionization chamber) showing excellent results [2]. After that, detectors were sent to the BR2 reactor (SCK•CEN, Belgium) to perform the Phase_2 tests in a mixed neutron-gamma field with high neutron fluxes and gamma dose rates, comparable with the expected values in the HFTM in IFMIF. The neutron spectra in all BR2 channels are dominated by the thermal neutron component. In order to get a more representative test for IFMIF conditions, the detectors were surrounded by a cylindrical gadolinium screen to cut the thermal neutron component. The accumulated gamma dose was about 4×10^{10} Gy and the fast neutron fluence (E>0.1MeV) 4×10^{20} n/cm².

The experiment aimed at providing the necessary information to check the integrity of the detectors, to verify the linearity of their responses and to obtain their calibration curves. The fission chambers were calibrated in three BR2 channels with different neutron-to-gamma ratio, and the long-term evolution of the signals was also studied. Additionally, the cable and gamma contribution to the signals was measured.

Finally, theoretical calculations performed with a numerical code developed for estimating the signals of the detectors in IFMIF [1] were validated by comparison with experimental values.

[1] D. Rapisarda et al., *Fusion Eng. Des.*, **84** (2009) pp. 1570-1574
[1] D. Rapisarda et al., ISFNT-9, Dalian, China (2009). October 11 – 16, PO3-118.