Triga Mark III reactor operating power and neutron flux study by Nuclear Track Methodology

G. Espinosa[a], J.I. Golzarri[a], R. Raya-Arredondo[b], S. Cruz-Galindo[b], L. Sajo-Bohus[c,*]

[a]Instituto de Física, Universidad nacional Autónoma de México
Circuito de la Investigación Científica, Ciudad Universitaria. México, DF, Mexico
[b] Instituto Nacional de Investigaciones Nucleares, Mexico
[c] Universidad Simón Bolivar, Laboratorio de Física Nuclear, Venezuela

Corresponding e-mail: espinosa@fisica.unam.mx

It is very well known that the Nuclear Track Methodology (NTM) is one often employed alternative for neutron detection and dosimetry, based on the neutron-proton interaction. In this paper the Triga Mark III reactor operating power and neutron flux, are studied using Nuclear Track Detectors (NTD). The facility of the "Instituto Nacional de Investigaciones Nucleares (ININ)", Salazar, México operate with a core load of 85 Highly Enriched Uranium (HEU) fuel elements and four control rods in an elongated pool filled with demineralized water, providing a neutron flux around 2 x 10^{12} n cm^{-2} s^{-1}.at the irradiation channel. The reactor core load has a total of 6036.00 g of U-235 (divided in 26 elements or Flip enriched at 70% further 59 standard elements enriched at 20 % and more three others fuel roads enriched at 70 %;. The experimental study was carried out at the channel No.1 , using CR-39 (allyl diglycol policarbonate) Landauer® as neutron detection material, with 3 mm acrylic sheet as moderator. The plastic detectors were chemically etched in 6.25M-KOH solution at 60±1°C for 6 hours so to make observable the formed latent tracks. Later on, the track density was determined by a custom made Digital Image Analysis System (DIAS). Results show a monotonic response between the reactor power in the range 0.1-7 kW and the average nuclear track density with data reproducibility and relatively low uncertainty (+/-7%). The presented method shows several advantages such as being a simple technique, fast and reliable method being a complementary alternative procedure to measure at the research reactor operating power that include the possibility to calibrate the neutron flux density measured at an unknown low reactor power.

This work was partially supported by UNAM-DGAPA-PAPIIT project IN-103013.
* Invited Professor at the IFUNAM, with financial support from "Catedra Angel Dacal"