Monitoring of a 14 MeV neutron source

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Accelerator-driven systems (ADS) may allow the transmutation of the most radiotoxic nuclear waste. They consist of the coupling of an intense high-energy proton beam, hitting a high atomic number target, and a sub-critical reactor core. For safety reasons, an on-line accurate and robust core reactivity monitoring is mandatory. The beam current delivered by the accelerator and the power level, or neutron flux, of the reactor core are strongly correlated through a proportionality relationship which has to be investigated, since, among different techniques, it could give access to any reactivity change.

To demonstrate the feasibility of such an on-line reactivity monitoring, an experimental program is planned at the YALINA facility, in Byelorussia, in the framework of the EUROTRANS Integrated Project (6^{th} FP). At this sub-critical installation, the incident 14 MeV neutron flux is produced by a deuteron beam impinging on a ^{3}H target. Due to the consumption of the ^{3}H target, the deuteron beam current will not remain proportional to the neutron production-rate over time. Therefore, in order to monitor the neutron production rate, we developed a new detector device. It is composed of a thin CH_2 foil, followed by three Si detectors. This telescope will be installed a few meters downstream the ^{3}H target, at 0°. The detection method is based on the conversion of neutrons into recoiling protons, which are then detected by the three Si. Their thicknesses and thresholds have been chosen so that the most energetic protons, associated with the 14 MeV neutrons, are stopped in the last stage of the telescope. Requiring triple coincidences in the telescope enable then to select events originating only from neutrons produced in the $d+^{3}H$ reactions. Doing so, the correlation between a change of the source intensity and the flux will be kept and the proportionality constant can be investigated and determined (via a calibration) and therefore used to detect any reactivity change of the sub-critical medium.

In this contribution, we will present the performances of this new neutron beam monitoring device. They were studied during a test experiment done at the GENEPI neutron source of the PEREN installation, in France. Comparisons with simulations will also be presented.

KEYWORDS: Eurotrans project, Yalina facility, accelerator-driven system, core reactivity monitoring, neutron detector, Peren facility.