DETECTOR DEVELOPMENT FOR NEUTRON IMAGING SYSTEM FOR RADIOACTIVE-WASTE ANALYSIS (NISRA) WITH 14 MeV Neutrons

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Radioactive waste has to undergo a process of quality checking in order to check its conformance with national regulations prior to its transport, intermediate storage and final disposal. Within the quality checking of radioactive waste packages non-destructive assays are required to characterize their radiotoxic and chemotoxic contents.

In a cooperation framework Forschungszentrum Jülich, RWTH Aachen University and the Siemens AG are studying the feasibility of a compact Neutron Imaging System for Radioactive waste Analysis (NISRA) using 14 MeV neutrons produced by a neutron generator. Fast neutron imaging is a promising technique to assay large and dense items providing in complementarity to photon imaging additional information on the presence of structures in radioactive waste packages. However due to the low neutron emission of neutron generators (10^8 to 10^{10} n/s in 4π) the challenging task resides in the development of an imaging detector (readout detector and neutron converter) with a high counting efficiency, a low sensitivity to gamma radiation and a resolution sufficient for the purpose. In this study two different readout detectors are studied. The first one is a large amorphous silicon flat panel and the second is a photomultiplier based detector with crossed wavelength shifting fibres. For both readout detectors the same type of neutron converter a simple plastic scintillator or a polypropylene resin mixed with ZnS as scintillation material is considered. The performance of the two detection systems are presented and compared. Furthermore some results of Monte-Carlo simulations for their optimization with respect to different neutron converter types are given.