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Development of active neutron non-destructive assay (NDA) techniques

The Japan Atomic Energy Agency (JAEA) and the European Commission-Joint Research Center (EC-JRC) are jointly developing nondestructive neutron-interrogation assay techniques for nuclear material accountancy applicable to both low and highly radioactive nuclear materials (NMs) and for nuclear security purposes (such as detection of nuclear and explosive materials). The techniques being developed are Differential Die Away Analysis (DDA), Delayed Gamma-ray Analysis (DGA), Neutron Resonance Transmission Analysis (NRTA), and Prompt Gamma-ray Analysis (PGA). Those techniques are used to mutually complement each other. In order to realize the concept, a multipurpose integrated system has been proposed and design work has been performed. Development of each technique is being carried out within the collaboration.

As the first step, an integrated DDA and PGA system has been constructed using a high intensity DT neutron source at the NUCEF facility of JAEA. Test measurements have been carried out to demonstrate that a Pu of 0.002-1 g in a small volume (vial bottle size) can be detected by DDA, and prompt gamma rays from nitrogen (contained in high explosives) and other elements contained in chemical warfare agents are detectable by PGA. DGA test experiments were performed using samples with different 235U:239Pu mass ratio at JRC Ispra to confirm a potential for analyzing concentration of fissile nuclides such as 235U and 239,241Pu. Development of NRTA was done at JRC Geel and Kyoto University. Usefulness for quantification of special NMs was examined. A size reduction study is now in progress.

One of the applications of these techniques in nuclear safeguards is for NM accountancy for present and future nuclear fuel cycles, including those for accelerator driven system. Measurements must be performed in a high radioactive environment due to fission products and long-lived minor actinides. In a reprocessing plant, for example, NDA measurement are required to perform for both low and highly radioactive NMs (e.q. spent nuclear fuels, MOX and purified nuclear fuels after the removal of FPs and minor actinides). The developed techniques can cover whole of the NDA measurements.

Which ”Key Question” does your Abstract address?

NEW1.2

Which alternative ”Key Question” does your Abstract address? (if any)

NEW1.6

Topics

NEW1

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