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The ENEA neutron active interrogation system for suspect materials characterization

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The neutron active interrogation (NAI) system, developed by the Italian National Agency for new technologies, energy, and sustainable economic development (ENEA), is a sensor whose purpose is the non-destructive inspection of samples in which is suspected the presence of fissile and/or fertile material. The ENEA NAI device is the combination of a neutron source, a moderator around the sample suspected of containing fissile material, and a neutron detector array. The interrogation neutrons, properly thermalized, induce fissions in the fissile material present in the sample, which can be followed by detection of neutrons emitted. Discrimination of neutron source from fission is based on the method of differential die-away time analysis, which is based on the different decay times of the neutron interrogation and those from induced fission. DDAA relies on measuring the time decay of neutrons produced by fission in a non-fissile medium by an appropriate pulsed neutron source. The performance analysis has been carried out using MCNPX (Monte Carlo N-Particle extended) simulation code to optimize the system. Such simulations results have been used during the device optimization process allowing develop an experimental setup that has been tested on the field. The NAI device, at its current development stage, allows detecting 6 g of ²³⁵U hidden in a package. It is easily transportable, light in weight, and with a real-time response. It is a prototype system and a promising base for further developments. This paper describes the NAI system at the current stage of development and its performances.

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