Contribution ID: **5** Type: **not specified**

(CAEN) Tests and performances of a Special Nuclear Material Identifier for Nuclear Threats and SNM in realistic scenarios

Monday, 14 December 2020 14:20 (20 minutes)

Increase of concerns in global nuclear security oblige to consider scenarios where the ability to detect and alarm in seconds and identify within 1 minute assuring the identification of a nuclear threats and SNM in more realistic scenarios of possible Shielding and Masking with high level of efficiency is highly required. This paper is presenting extensive test results of a research that have been conducted for more than 4 years towards the realization of a portable advanced systems for the measurement and identification of radioactive material for example, in illicit trafficking capable to address complex scenarios such as Shielding and Masking and at the same time determine in real time a fully, without the need to require other support from experts to determine exactly the Threat including the determination of presence of SNM isotopes : U, Pu-239, PuWG, UWG, Am-Be, Am-Li, or a combination of Shielding and Masking scenarios. The performances of the devices are exceeding the actual referenced standards, especially in sensitivity and furthermore because is the only instrument that will be available for "Interdiction"in the world to execute in real time SNM identification. Typical detection time for this kind of measurement is 1s for gamma emitters, 2s for neutron emitters and 1 minute for identification including shielding. This paper presents a breakthrough portable radioactive isotope identifier. This device, based on an organic liquid scintillator with excellent Pulse Shape Discrimination (PSD) proprieties for the simultaneous detection of gamma rays and neutrons, detects radioactive source as Special Nuclear Material (SNM), medical, industrial and Naturally Occurring Radioactive Material. The exclusive feature of this instrument is the identification of neutron sources with discrimination between fission sources (like Californium 252Cf) and alpha-n type sources (like Americium Beryllium Am-Be) from Plutonium and Uranium through an innovative dedicated parallelized algorithm by using only the neutron detection. Individual thresholds for neutron and gamma counts are calculated to allow detection with 95% detection probability for a dose rate on the front face of the scintillator of at least 50 nSv/h. Alarms are triggered separately when the respective rate exceed these thresholds. The neutron source detection has also been proved in a gamma ray field up to 100-300 μSv/h. The electronics is equipped with two analog inputs and two high voltage power supplies in a small form factor thus becoming an enabling technology for higher performance yet portable radioactive isotope identifier devices, which can include more detectors and perform data fusion analysis. The addition of a second detector allows to detect a masked neutron source through the PSD algorithm performed by the liquid scintillator detector while the added inorganic scintillator identifies the masking gamma emitters. The inorganic scintillator allows also the calculation of Pu and U enrichment grade through characteristic gamma emission line.

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Session Classification: Sessione industriale