FISSILE MATERIAL DETECTION AND CONTROL FACILITY WITH PULSED NEUTRON SOURCES AND DIGITAL DATA PROCESSING

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In connection with possible nuclear terrorism, there is long-felt need of devices for effective control of radioactive and fissile materials (FM) in the key points of crossing the state borders (airports, seaports, etc.), as well as various customs check-points.

In ISTC Projects No. 596 and No. 2978, a new physical method and digital technology have been developed for the detection of fissile and radioactive materials in models of customs facilities with a graphite moderator, pulsed neutron source and digital processing of responses from scintillation PSD detectors. Detectability of fissile materials, even those shielded with various radiation-absorbing screens, has been shown [1]. The use of digital processing of scintillation signals in this facility is a necessary element, as neutrons and photons are discriminated in the time dependence of FM responses at such loads on the electronic channels that standard types of spectrometers are inapplicable. Digital processing of neutron and photon responses practically resolves the problem of dead time and allows implementing devices, in which various energy groups of neutrons exist for some time after a pulse of source neutrons. Thus, it is possible to detect FM deliberately concealed with shields having a large cross-section of absorption of photons and thermal neutrons.

Two models of detection and the control of fissile materials were advanced:

1. the model based on graphite neutrons moderator and PSD scintillators with digital technology of neutrons and photons responses separation;

2. the model based on plastic scintillators and detecting of time coincidences of fission particles by digital technology.

Facilities that count time coincidences of neutrons and photons occurring in the fission of fissile materials (FM) can use an AmLi source of neutrons, e.g. that is the case with the AWCC system [2]. The disadvantages of the facility are related to the issues of a radioisotope source operation. Those include impossibility to shut down the neutron flux during the downtime and transportation of the facility, as well as the necessity to guard the source. In addition, the measurement chamber of the facility is insufficiently large to inspect FM samples placed in protective AT-400 type containers; also, in case the source is damaged, the premises could be contaminated. Elimination of these disadvantages concurrently with increasing the informativeness of the coincidence count systems can be achieved by the use of digital technology to detect the response of FM neutrons and photons in fast scintillation systems, and application of a DD neutron generator. The use of scintillators allows detecting also fission photons, beside neutrons, which increases the multiplicity of particles, and hence, efficiency of the facility.

References

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2. H.O.MENLOVE. “Description and Operation Manual for the Active Well CoincidenceCounter” Los Alamos, report LA-7823-M, 1979.