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# Active Interrogation System for Special Nuclear Materials: Principles and Initial Results

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Non-destructive inspection systems are essential for preventing terrorist threats and the smuggling of special nuclear materials (SNM) at airports and seaports. For decades, investigating SNMs such as Pu-239 and U-235 has been a primary concern of nuclear security efforts worldwide. This work presents experimental results from a novel, portable active interrogation system for the non-destructive detection of SNMs.
The system is based on threshold energy neutron analysis, utilizing a portable DD (2.45 MeV) neutron generator with an intensity of 5×107 n/sec to actively interrogate materials. It is coupled with arrays of tensioned metastable fluid detectors (TMFDs). In the presence of fissile material, prompt fission neutrons are emitted with an average energy of approximately 2 MeV, with ˜30% having energies higher than the DD source neutrons.
Experiments were conducted with 10 kg and 20 kg natural uranium (NU) metal samples placed inside an inspection volume of 1 m3. A series of 30-minute measurements, with and without NU, were performed at a DD neutron source intensity of 106 n/sec and repeated multiple times. The neutron count rates were consistently higher with NU compared to without NU.
Using the experimental count rates, probabilities of detection (PD) and false alarm (PFA) were evaluated. For this analysis, the neutron source intensity was set to 5×107n/sec, and the inspection time was reduced to under 90 seconds. The results showed a PD of ˜98.7% for detecting 10 kg NU (containing ˜70 g U-235) and >99% for 20 kg NU (containing ˜170 g U-235), with a PFA of <5%. These results are encouraging compared to the target values (PD >90% and PFA <5%) outlined in ANSI standards.
The portable active interrogation system, experimental setup, and results will be discussed at the meeting.

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