HAW05-2005-020103

Abstract for an Invited Paper
for the HAW05 Meeting of
the American Physical Society

Detection of well-shielded special nuclear material in cargo containers via active neutron interrogation

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Approximately 6 million cargo containers arrive at U.S. seaports annually, carrying up to 30 tons of non-homogenous cargo each. Highly enriched uranium (HEU) and other special nuclear material concealed inside these containers is difficult to detect with existing portal monitors. This is due in part to the attenuation of low energy γ-rays in the cargo. A new system is currently being developed to reduce the likelihood of false-negative and false-positive detections of fissile material in the cargo, without slowing the flow of commerce through the port. The technique utilizes a neutron beam to induce fission, and a wall of plastic scintillators to detect subsequent delayed high-energy γ-rays after β-decay of the fission products [1]. The delayed γ-rays above 3 MeV are highly penetrating and have energies above natural background radiation. Because half-lives of most of the fission products are less than 160 seconds, decay curves over 100 second intervals become an efficient diagnostic. Previously, experiments using 14 MeV neutrons with HEU hidden in wood and steel have shown the ^{16}O(n,p)^{16}N reaction to be a significant interference due to 6 MeV γ-rays produced from the decay of ^{16}N. New experimental work using a 3-7 MeV broad spectrum neutron beam will be presented and compared to simulations and past experimental results. This work is performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory contract No. W-7405-Eng-4.

[1] E.B. Norman *et al.*, Nucl. Instr. Meth. A, **521**, 608 (2004).