SEARCHING PLUTONIUM FROM A TRAVELLING VEHICLE BY NEUTRON MEASUREMENTS

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For the search and detection of concealed nuclear material and neutron sources we have equipped a conventional car with a neutron measurement system. It consists of six neutron slab counters on each side. Each slab counter has a size of approx. 25 x 50 x 9 cm^3 and contains 6 He-3 tubes embedded in polyethylene covered by stainless steel. The active length of the tubes is 33 cm and the diameter 2.54 cm. The efficiency of all six slab counters on each side is 0.66 % for the detection of Cf-252 fission neutrons emitted from a point source in a distance of 100 cm from the center of the detectors. The complete system is mounted in a square steel rod assembly so that it can be fixed in most vehicles easily. Between the racks for the detectors we have fastened a voltage converter and the electronics. A view of this system installed into a car is shown in figure 1.

Figure 1: Car with neutron slab counters and accessory electronics

The pulses of the six modules on each side are summed passively and each side is analyzed separately. The results can be displayed on a handheld PC in the front of the car or in case of a covered search the data can be stored in a non-volatile memory in the electronics. For a clear location these data will be synchronized with a GPS signal.

A measurement performed with a car equipped with this neutron detection system is shown in figure 2. We placed a small neutron source (Cf-252) two meters away from the driving way of the car. The neutron intensity corresponds to less than 10 g reactor plutonium with a burn up of 30 GWd/t. The results show a very clear signal on the right side whereas the signal from the left row of the detector modules is only slightly above background.

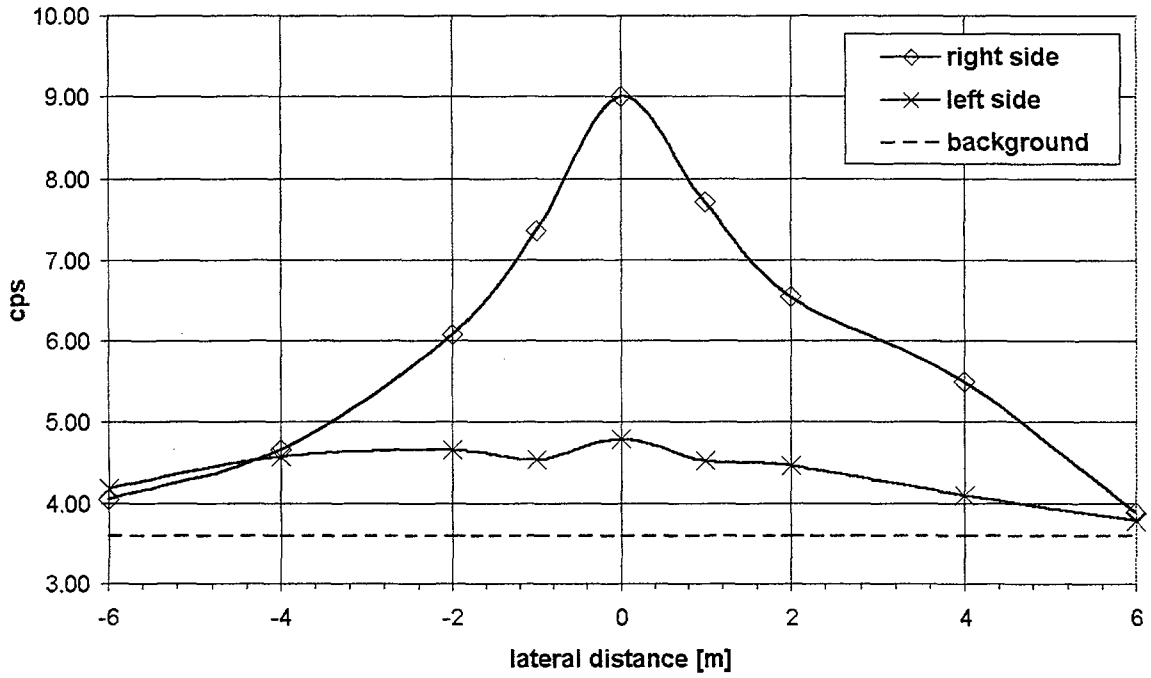

Figure 2: Count rates from a Cf-252 source (activity 25.9 kBq), 2 m away from the right side of the car

In addition we have performed measurements in practical operation. The typical neutron background was 10 cps on the test site. A neutron source (Cf-252) was hidden inside a house in the ground floor approx. 1 m above the floor. The neutron intensity of this source was 1.86 10^5 n/s (in 4π). This corresponds to about 530 g reactor plutonium (burn up of 30 GWd/t) or even less for higher burn up. In case of weapon grade plutonium this neutron intensity corresponds to a quantity of 3.5 kg. When driving slowly (velocity approx. 10 km/h) past the house in a distance of about 5 m a significant rise in count rate of up to 130 cps was monitored in the module row faced toward the house. Passing on the street in a distance of 10 m still a rise in count rate was monitored for velocities up to 10 km/h: we measured 25 – 30 cps.

For strong sources neutron coincidences may be measured in addition. If coincidences are recorded this is a clear evidence for fissionable material. The measurements show that such fissionable material can be detected clearly and easily from a car. This system may be used to discover illicit trafficking of nuclear material and to prohibit nuclear proliferation.