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Handheld Instruments for Landmine Detection: View from Radiation Dosimetry

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Abstract

Landmine detection, based on nuclear methods, uses either the neutron backscatter measurements to discriminate the soil from the mine, which has higher hydrogen and carbon content and hence is a better moderator than the soil, and/or relies on the H:C:N ratios determined via gamma-ray spectroscopy. Instrument design for landmine detection faces many challenges: safety, signal-to-noise ratio, and false alarms. Design of handheld and vehicle-mounted instruments using nuclear measurement methods has been studied to date. In the design of handheld instruments, the factors that are taken into account include the weight of the instrument, the portability of the instrument by the operator, source strength, source type, detector sizes, and measurement time for good signal-to-noise ratio and to avoid false alarm rates. Design studies described in the literature have been carried out by looking into the detection limits as a function of soil type, moisture, and density; mine depth and size; detector size and offset; and interferences from rock or other objects beneath the soil. In some cases, the source is shielded to thermalize the neutrons and thus to increase the thermalization in the soil.

The obvious and imminent danger of using handheld instruments is the detonation of the mine, resulting in potentially serious injury or death. When radioactive sources are used for detection purposes, radiation protection of the operator needs to be taken into account as well. However, the operator has not been included in any of the design studies found in the open literature. The dose rate received by the operator depends not only on the characteristics of the source but also on the soil type, density, and moisture content; the distance between source and the operator; and the shielding around the source and instruments. We have performed a limited number of analyses to determine the dose rate to the operator for some of these variables. In this paper, the preliminary results of the organ and effective dose for the operator, using a mathematical model of the Oak Ridge National Laboratory (ORNL) phantom with Monte Carlo computations, are presented.

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