THE DEVELOPMENT OF A MINIATURE INTEGRATED NUCLEAR DETECTION SYSTEM FOR USE IN HOMELAND SECURITY DEPLOYMENTS*

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Prior to 9/11 the Princeton Plasma Physics Laboratory was developing real time assaying techniques for measuring low energy radionuclides in high background environments. These measurements were mainly associated with the detection of tritium co-deposited on the top ~50 microns of the Tokamak Fusion Test Reactor (TFTR) (graphite) bumper limiter tiles. For this purpose multiple (in situ) radiation detectors were configured to collect low energy beta and bremsstrahlung signals which were resident in the highly activated vacuum vessel. Due to the difficulty associated with positioning the detectors within the TFTR vacuum vessel a successful effort was undertaken to miniaturize the devices. Post 9/11 it became evident that low level radiation detection technology developed at TFTR could have application in Homeland Security deployments. Currently it is estimated that approximately 120,000 persons in the U.S. carry trace quantities of detectable medical isotopes from diagnostic and therapeutic procedures [1]. In addition the transportation of authorized radioactive materials for industrial, research, and medical purposes is prolific. The real time detection and identification of authorized radionuclides from unauthorized radionuclides, that could possibly be used in a radiological dispersion device (RDD), is a high priority for security personnel in the post 9/11 era. The Miniature Integrated Nuclear Detection System (MINDS) is designed to identify, in real time, radionuclides at levels slightly above background in mixed and noisy environments. The system is configured to detect x-rays, soft gamma rays, gamma rays, and neutrons with a high degree of accuracy. Emphasis on rapidly identifying those radionuclide(s) which have been identified as high threat materials by security personnel is a main function of the system. MINDS employs mostly off-the-shelf components coupled to proprietary peak fitting and neural networking software. The paper will discuss the detector configuration including algorithm development and test results.

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