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SURVEY OF RADIATION LEVELS AT ITHEMBA LABS USING A MOBILE RADIATION DETECTION UNIT EQUIPPED WITH A LaBr₃:Ce DETECTOR

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A mobile radiation detection unit (MRDU) was developed to measure the radiation levels outside the iThemba LABS buildings, within the borders of the facility. The main attraction of this mobile unit is the fact that it is equipped with a LaBr₃:Ce detector. This detector is superior to more conventional detectors (such as NaI:Tl) because of typically better spectral resolution, a high photon yield, and good detection efficiency [1, 2, 3]. It is known that the LaBr₃:Ce detector has various sources of intrinsic activity of which the main cause is the presence of the radioactive ¹³⁸La-isotope in the scintillation crystal [4]. One of the decay modes of ¹³⁸La produces a gamma photon at 1435.8 keV which overlays with the ⁴⁰K energy peak at 1460.8 keV when the detector resolution is taken into account. To quantify ⁴⁰K activity this internal interference needs to be corrected. Additional to this, the influence of the radiation-source geometry also needs to be considered, especially during terrestrial surveys. This has a direct influence on detector efficiency which is a fundamental parameter for the accurate calculation of activity concentrations for the various radionuclides present in natural environments. Using the mobile radiation detection unit an assessment of radiation at the outside areas of the iThemba LABS facility was done. It was possible to elucidate the naturally occurring nuclides as well as ²²Na from the gamma-ray spectra obtained. Due to the constant change in this geometry at the storage containers the ²²Na, in particular, could only be estimated. Considering background radiation as well as the intrinsic radiation from the detector due to the presence of radioactive ¹³⁸La, the activities of the nuclides were estimated to be 49.1 Bq/kg for ⁴⁰K, 3.78 Bq/kg for ²³⁸U, 12.8 Bq/kg for ²³²Th and 72.5 kBq for ²²Na. The effective dose rate of the NORM-nuclides was calculated as 0.0043 mSv/y.

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