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A Planned Calibration Facility For In-Situ Gamma-Ray Detectors

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In-situ measurements are affected by changes in the geometry of the landscape. Due to these challenges, a dedicated calibration facility is required. The calibration facility is best optimized by making use of a combination of Monte Carlo simulations and a dedicated measurement setup, MEDUSA system. With the simulation, one can optimize the dimensions of the calibration facility, the type of material to be used and the geometry. The use of Monte Carlo simulations is used in instances, where measurements would require too much time, expensive or are even impractical to consider and moreover to account for the differences between the calibration and other geometries.

Various types of samples of bricks were acquired, crushed and measured using the hyper-pure germanium (HPGe) detector, a laboratory-based setup used to count low-level radiation samples. The results of the HPGe detector system was used to calculate the activity concentrations of 40K, 232Th and 238U decay series. In addition, the type of the brick to be selected will depend amongst others on the homogeneity of the sample.

The brick castle is constructed at iThemba LABS, Cape Town, Western Cape, South Africa. The brick castle has dimensions of 121 cm height, 119 cm width and 134 cm depth with a 10 cm PVC tube, facing upwards, for inserting a detector for measurements. Initially, the brick castle is designed to house an 8 cm diameter detector (MEDUSA). It has a wall thickness of 55 cm (width) and 63 cm (depth) to reduce the background radiation from reaching the detector. On completion of the brick castle, activity measurements were taken in order to create spectra of the natural-occurring radionuclides (40K and radionuclides from the 232Th and 238U-series). These spectra were converted to create what we call standard spectra for the castle geometry.

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