



# RAP 2023

**INTERNATIONAL CONFERENCE  
ON RADIATION APPLICATIONS**

In Physics, Chemistry, Biology, Medical Sciences,  
Engineering and Environmental Sciences

# BOOK OF ABSTRACTS



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## BOOK OF ABSTRACTS

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## Quality control of NaI scintillation detector for gamma spectrometric determination of radon concentration

**Ivana Vukanac, Milica Rajacic, Jelena Krneta Nikolic,  
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Measurement of radon ( $^{222}\text{Rn}$ ) concentration using charcoal filters according to the EPA 520/5-87-005 method is performed in Radiation and Environment Protection Department of Vinča Institute for Nuclear Sciences on NaI scintillation detectors. Concentration of radon adsorbed on active charcoal is determined indirectly, by gamma spectrometry of its daughter products via their gamma peaks at 295 keV, 352 keV ( $^{214}\text{Pb}$ ) and 609 keV ( $^{214}\text{Bi}$ ).

In order to assure the reliability of the measurement results, and in accordance with Standard ISO 17025/17 quality control and quality assurance (QA/QC) procedures needs to be applied. Related activities ought to be planned, described in the quality control documentation, performed in a systematic manner, recorded and reviewed.

First, the energy and efficiency calibration of the detection system needs to be performed in a proper manner. The NaI scintillation spectrometer is internally calibrated using the certified radioactive  $^{226}\text{Ra}$  standard in charcoal matrix and in the geometry identical to the measurement geometry, produced by Czech Metrology Institute and traceable to Bureau International des Poids et Mesures (BIPM).

As defined in laboratory's procedures a regular quality control of the NaI scintillation detector is performed once a week. Quality control activities include the background measurement and measurement of adequate reference material. Gross background count rate in the energy region of interest is used to verify that the detector and shield have not been contaminated and that there is no significant variation of the background. Reference material used is the soil sample with known content of  $^{226}\text{Ra}$ . Gross count rate in the reference material spectrum is used to check the energy and efficiency calibration. These values are recorded and verified if they are within the acceptance limits. Obtained results, together with acceptance limits, for a certain period (one year usually) is graphically presented in the control charts.

The acceptance limits for background count rate and reference material gross count rate in the energy region of interest are defined according to the statistical analysis of the data from previous QC period. The mean and standard deviation is calculated and the acceptance limits are set to be  $\pm 2\sigma$  and  $\pm 3\sigma$ .

QC measurement results falling between  $\pm 2\sigma$  are considered to be satisfactory, while those falling inside  $\pm 3\sigma$  are warning. QC measurement results exceeding  $\pm 3\sigma$  indicate that there is a problem with the measurement system and that analysis of causes and design and application of corrective measures are needed.

Analysing the control charts for the previous QC period (year 2022) showed that the controlled parameters were within the defined limits of acceptance. Occasional discrepancies, mainly due to background variation, were minor and were addressed immediately. Background variation was treated simply by repeated measurements after additional ventilation of the measurement laboratory.

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