Methodology development for Gamma-spectrum analysis

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The Argonauta research reactor, located at the Nuclear Engineering Institute (IEN), since 1962, offers various services to the Brazilian society through its extension, research, education and training programs [1]. These services require a series of quality control and validation processes. For example, laboratories must demonstrate, through validation, that the methodology they use leads to reliable results [2]. National Program for the Intercomparison of Results of Environmental Sample Analysis (PNI) is a laboratory intercomparison program developed throughout the national territory that involves different research areas, including gamma ray spectrometry. LNMRI (Brazilian Laboratory Ionizing Radiation Metrology) conducts PNI. Its main objective is to determine the laboratories' performance and classify the laboratories as good, acceptable or out of control, and improve the quality of the attending laboratories. To participate in a PNI round is an excellent approach to assure reliable results. Nuclear Measurement Laboratory (LMN) is one of the Argonauta's facilities where the methodology to be developed will use certified and screened samples from the PNI program that consists of radioactive materials cocktails. In this methodology development, two original cocktails will be used: one containing anthropogenic materials (Ba133, Co-60, Cs137, Cs-134, Ru-106, and Zn-65) and the other containing artificial elements (Ra-226, Ra228 and U-238). Moreover, original samples and diluted ones in nitric acid will be measured and compared. As PNI is a program aimed at environmental samples, such cocktails have an activity concentration of less than 37 Bq/l, increasing the need for the developed methodology and good statistical treatment accuracy. This low concentration is near the minimum detection limit of the system used, forcing the laboratories to create solid methodologies that minimize errors and reproducible results. The LMN detection system available to run this work comprises a high resolution spectrometer, a semiconductor detector of hyperpure germanium (HPGe), with a relative efficiency of 20% and model GEMF5930 from ORTEC (Figure 1). This work presents the selected parameters for a methodology development to validate the gamma-spectrum analyses performed in the HPGe system of LMN.

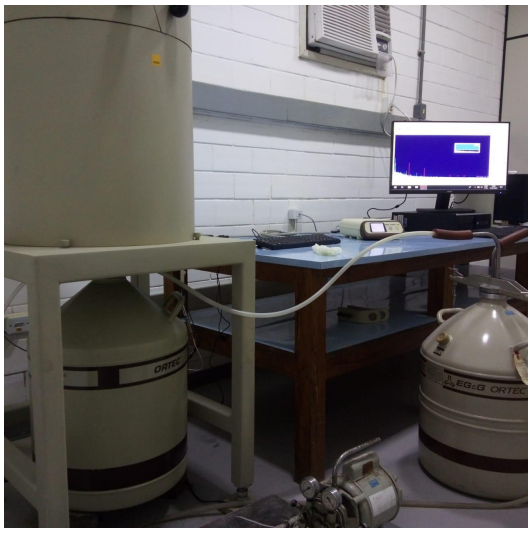

Figure 1. HPGe detection system

A cylindrical geometry with volumes ranging from 100 ml to 500 ml will be used in the counting process. Also, the counting time will vary from 1h to 24h. Besides, the best geometry will be combined with the best counting time to provide results consistent with the required quality. Statistics tests will be applied to the obtained results to evaluate methods reliability. Also, diluted samples measurement will be performed to track possible problems in the dilution process besides evaluating the effect of this dilution on the results reliability.

References

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