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TEMPORAL EVALUATION OF RADIATION DETECTION SYSTEM USED BY IN DIVISION OF RADIATION PROTECTION OF THE NAVY TECHNOLOGICAL CENTRE IN SÃO PAULO

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ABSTRACT

This work presents a temporal evaluation of the radiation detection system used by in division of radiation protection of the CTMSP, São Paulo, Brazil. About fifty efficiencies results of the system were compiled over the last two years for this purpose. Less than 1% of the standard deviation was found for both portable and fixed detectors, which indicates a significant stability of the detection system used in CTMSP over the period analyzed.

1. INTRODUCTION

The components of nuclear instrumentation, including detectors, associated electronics and multichannel analyzers, are always subject to fluctuations due to various factors such as fluctuations in the electric grid and weather conditions. Furthermore, the instability of the background radiation is a factor that can seriously compromise quality of measurement results. It is therefore of fundamental importance that be checked periodically operating conditions of instrumentation and their stability. This frequency should be consistent with the demands of each detection system [1].

It is the responsibilities of radiation safety of the installation maintain a program monitoring in the facilities, which among other functions performs routine checks on the facilities. The routine monitoring program consists basically in to survey the conditions of the workplace in order to prove that such working conditions, including the values of individual doses, remain satisfied with the course of time [2]. For this purpose, division of radiation protection of CTMSP uses portable and fixed detectors, such as Geiger-Muller counters and monitors indirect reading of feet and hands.

To ensure that the device detection is operating correctly, a rigorous study of the quality assurance of equipment is necessary.

In this study, the efficiencies were used to evaluate the temporal stability of the devices used by the CTMSP radioprotection. The methodology applied in this study is detailed in the next section.

2. MATERIALS AND METHODS

The procedure for quality control of devices consists of periodic measurements of background (BG) radiation and two circulars sources (two inches in diameter each) of Am-241 and SrY-90 (Table 1) with the counting time of 1 minute and simultaneous recording of results. The sources have an activity known as calibration certificate and are used as standard by the division of radiation protection of CTMSP.

Table 1: Set data of the circular sources used by the division Radiation Protection in the facilities of CTMSP for quality control of detectors

Standard sources	^{241}Am	^{90}Sr-Y
Activity (dpm)	2080674	17406
Calibration date	07/08/2002	07/08/2002
Half-Life (years) [3]	432,6	28,8

In this work three detectors were evaluated and are presented in following figures (1, 2 e 3):

- One portable (Figure 1): type Geiger-Muller.
  Manufacturer: Victoreen; Model: 190; Country: USA.
  This monitor is used daily in the facilities of CTMSP, aims to check levels of radiation dose at the ambient.

- Two fixed (Figures 2 and 3); counters alpha and beta particle.
  Manufacturer: Victoreen; Model: 190; Country: USA.
  These monitors are also used daily in the facilities of CTMSP, and aims to provide a count of smears for identification of possible surface contamination the measured area.

Figure 1: Portable Monitor: Geiger-Muller with pancake probe type for the surfaces

Figure 2: Fixed Monitor (SAC-4): scintillation alpha counter

Figure 3: Fixed Monitor (BC-4): beta counter

The efficiency test was performed monthly for each device under study and basically consists of acquiring ten counts for background radiation, and ten counts for the both standard sources emitting alpha and beta particles. For each equipment has been generated a document of measurement instruments were recorded in which the values of all readings and other pertinent data at test. From the data set for each source more standard values of background radiation was possible to obtain the value of the efficiency of the instrument with the following empirical formula used on the routine in division of radiation protection [4].

$$E(\%) = \frac{[Leitura(cpm) - BG(cpm)]x100}{AtividadedaFonte4\pi(dpm)} \qquad (1)$$

3. RESULTS AND DISCUSSIONS

About fifty efficiency results were compiled in the last two years for this purpose. After this, of data obtained during the study period, it was possible to treat the results using the software Microsoft Excel. The data set comprises two years: 2009 and 2010.

Figure 4 shows the behavior of the efficiency in percentage in relation to their average during the months of the year 2009 for the model SAC-4, alpha counter.

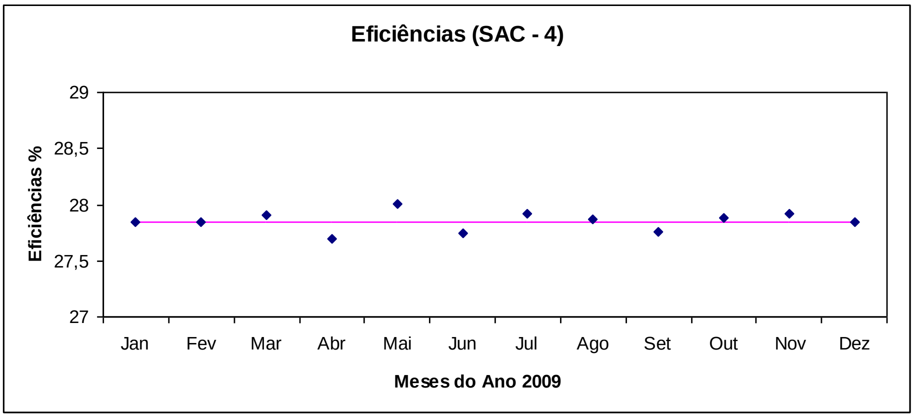

Figure 4: Efficiency values for the alpha counter in 2009

Figure 5 shows the behavior of the efficiency in percentage in relation to their average during the months of the year 2010 for the model SAC-4, alpha counter.

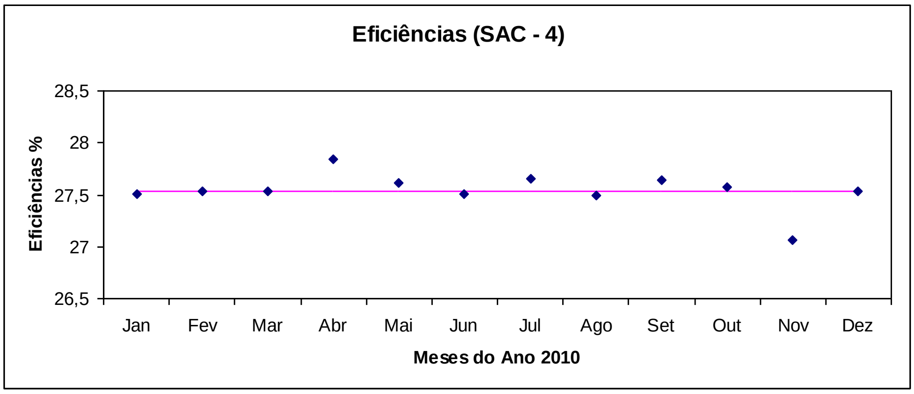

Figure 5: Efficiency values for the alpha counter in 2010

Table 2 presents the average values for the efficiency and standard deviation obtained for the alpha counter, model SAC-4, during the years 2009 and 2010.

Table 2: Average efficiency values and standard deviations for years 2009 and 2010, of the alfa counter

Year	Average Efficiency	Standard Deviation
2009	27,85 %	0,10 %
2010	27,54 %	0,11 %

The analysis of each data set has standard deviation less than 1%. This value indicates great stability of measurements throughout the study period.

Figure 6 shows the behavior of the efficiency in percentage in relation to their average during the months of the year 2009 for the model BC-4, beta counter.

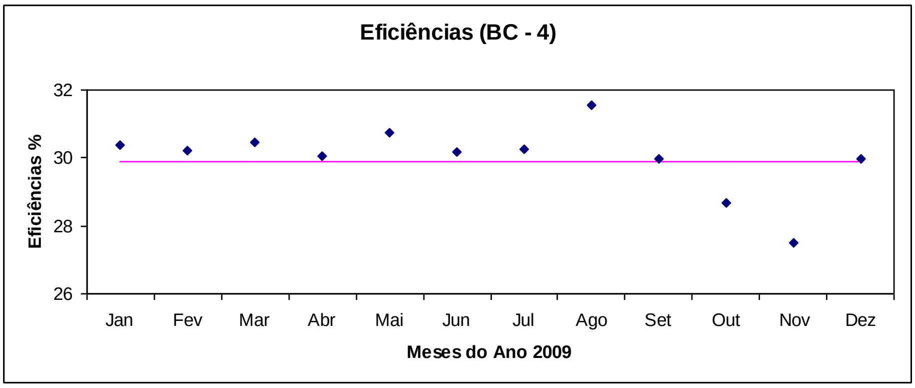

Figure 6: Efficiency values for the beta counter in 2009

Table 3 presents the average values for the efficiency and standard deviation obtained for the beta counter, model BC-4 in 2009.

Table 3: Average efficiency values and standard deviations for year 2009, of the beta counter

Year	Average Efficiency	Standard Deviation
2009	29,99 %	0,27 %

The analysis of each data set also has standard deviation less than 1%. This value indicates great stability of measurements throughout the study period. The same device was exchanged for another model at the beginning of the year 2010, so it was not possible to monitor the behavior of the efficiencies for the same year.

Figure 7 shows the behavior of the efficiency percentage in relation to their average, source emitting of alpha particles during the months of the year 2009 for the Geiger-Muller monitor.

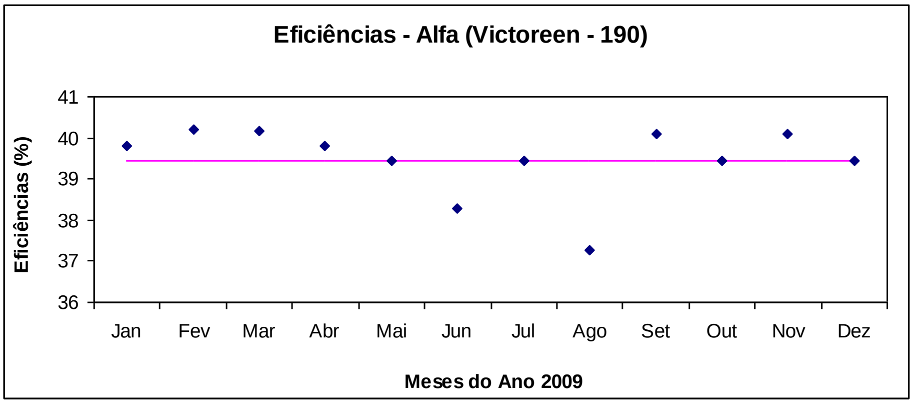

Figure 7: Efficiency values for the Geiger-Muller monitor for the source emitting of alpha particles in 2009

Figure 8 shows the behavior of the efficiency percentage in relation to their average, source emitting of beta particles during the months of the year 2009 for the Geiger-Muller monitor.

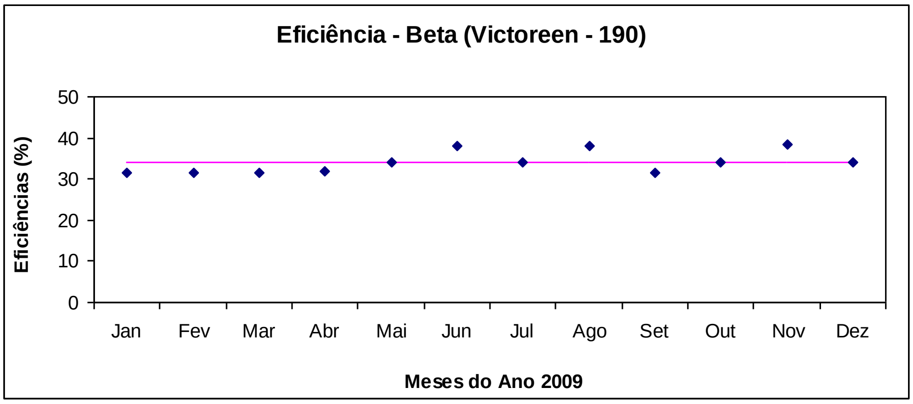

Figure 8: Efficiency values for the Geiger-Muller monitor for the source emitting of beta particles in 2009

Table 4 presents the average values for the efficiency and standard deviation for the alpha particle emitting source and the source emitting beta particles obtained by Geiger-Muller monitor in 2009.

Table 4: Average efficiency values and standard deviations for year 2009, of the sources emitting alpha and beta particles

Year	Average Efficiency (α)	Standard Deviation (α)	Average Effciency (β)	Standard Deviation (β)
2009	39,46 %	0,51 %	34,05 %	0,47 %

The analysis of each data set also showed a standard deviation of less than 1%. This value again indicates a high stability of measurements over the analysis period for both alpha and beta particles for in portable monitor.

4. CONCLUSIONS

The data analysis shows that a fluctuation of less than 1% of the standard deviation was found for both portable and fixed detectors, which indicates a significant stability of the detection system used in CTMSP over the period analyzed.

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