

Implantação do Laboratório de Calibração de Monitores Gama (LABCAL) do Instituto de Defesa Química, Biológica, Radiológica e Nuclear (IDQBRN) do Centro Tecnológico do Exército (CTEx)

Implementation of the Gamma Monitor Calibration Laboratory (LABCAL) of the Institute of Chemical, Biological, Radiological and Nuclear Defense (IDQBRN) of the Technology Center of the Brazilian Army (CTEx)

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Resumo: O presente trabalho tem como objetivo apresentar as etapas de implantação e de adequação do Laboratório de Calibração de Monitores Gama (LABCAL) do Instituto de Defesa Química, Biológica, Radiológica e Nuclear (IDQBRN) do Centro Tecnológico do Exército (CTEx). A calibração dos monitores de radiação usados pelo Exército Brasileiro será realizada através das medições da grandeza dosimétrica "dose equivalente ambiente", em cumprimento à legislação nacional. O LABCAL ainda busca licenciamento junto à CNEN e ao INMETRO. Este laboratório visa atender a demanda de calibração de instrumentos detectores e identificadores de radiações ionizantes utilizados em todo o Exército Brasileiro.

Palavras-chave: metrologia, calibração gama, radiação ionizante.

Abstract: The objective of this work is to describe the implementation and adaptation stages of the Gamma Monitor Calibration Laboratory (*Laboratório de Calibração de Monitores Gama - LABCAL*) of the Institute of Chemical, Biological, Radiological and Nuclear Defense (*Instituto de Defesa Química, Biológica, Radiológica e Nuclear - IDQBRN*) of the Technology Center of the Brazilian Army (*Centro Tecnológico do*

Exército - CTEEx). Calibration of the radiation monitors used by the Brazilian Army will be performed by quantitatively measuring the ambient dose equivalent, in compliance with national legislation. LABCAL still seeks licensing from CNEN and INMETRO. The laboratory is intended to supply the total demand for calibration of ionizing radiation devices from the Brazilian Army

Keywords: metrology, gamma radiation calibration, ionizing radiation.

1. INTRODUCTION

In Brazil, there are currently only seven accredited laboratories for calibration of ionizing radiation measuring instruments. As listed in a document issued by "CASEC / IRD / CNEN Certified Laboratories" (IRD, 2016) they are:

1. Laboratório Nacional de Metrologia das Radiações Ionizantes do IRD (Instituto de Radioproteção e Dosimetria);
2. Centro de Desenvolvimento de Tecnologia Nuclear (CDTN);
3. Universidade Federal de Pernambuco (UFPE);
4. Instituto de Pesquisas Energéticas e Nucleares (IPEN);
5. Laboratório de Ciências Radiológicas da UERJ (Universidade Estadual do Rio de Janeiro);
6. Laboratório de Calibração de Monitores de Radiação da METROBRAS (Centro de Ensaios e Pesquisas em Metrologia), e;
7. Laboratório de Calibração de Monitores de Radiação da ELETRONUCLEAR – Eletrobrás Termonuclear S.A..

The need for implementation of the Gamma Monitor Calibration Laboratory (in Portuguese: *Laboratório de Calibração de Monitores Gama - LABCAL*) mostly results from the growing demand from the Brazilian Army (in Portuguese: *Exército Brasileiro - EB*) for calibration of ionizing radiation measurement detectors. Such detectors are of paramount importance to secure the radiological safety in high visibility events and in cases radiological emergencies occur. In addition, they are also used for training, testing and preparation of personnel and equipment, including ready-to-deploy specialized troops for prompt action when necessary. Currently, the

Brazilian Army owns over 250 monitors of ionizing radiation, which in the future will be calibrated in this laboratory. The legislation currently enforced in Brazil requires that calibration be performed once a year.

2. METHODOLOGY

The description of the LABCAL deployment will be presented in four steps.

2.1. Description of the building

A building site located on the ground floor of the Radiation and Nuclear Defense Section (in Portuguese: *Seção de Defesa Radiológica e Nuclear - SDRN*) of IDQBRN was selected to house LABCAL. Figure 1 shows the floor plan of the room. The choice for the new location was due to the construction characteristics of the new laboratory. The boundary walls of the room and the entrance labyrinth, which make up the secondary barriers, were shielded with barite mortar and the primary barrier used is a concrete wall 30 cm thick, capable of receiving the primary beam from an gamma facility containing two sources (^{137}Cs and ^{60}Co).

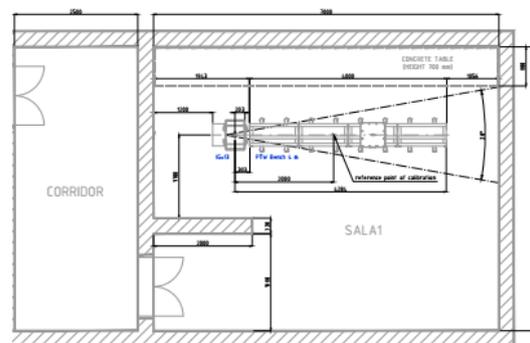


Figure 1 – View from above of the ground floor of the selected building site for LABCAL assembly (source: authors)

2.2. Equipments

In order to increase the laboratory capacity of IDQBRN, the equipment listed below was acquired for LABCAL operation and shown in figure 2:

- Gamma calibration facility, with capacity for three sources. Now we have two sources, one ^{137}Cs and another of ^{60}Co , both with activity of 1 Ci (37 GBq) each, measured in January 2016, in order to calibrate ambient dose equivalent rate from tenths $\mu\text{Sv/h}$ up to units of Sv/h ;
- Manual positioning system in 3 axes, consisting of 4,00 m in length of rail, 0,50 m of adjustment in the width (on the exposure bench) and 0,35 m of adjustment in the height;
- Two lasers for positioning and centralization of the detectors to be irradiated;
- Computer that functions as a control desk for exposure and collection of radiation sources; two one liter PTW TW32002 standard ionization chambers with PTW electrometers;
- A thermometer with resolution of 0.1°C ;
- A barometer with resolution of 0.1 hPa;
- A hygrometer with resolution of 1% relative humidity.
- TCP/IP camera monitoring system for room surveillance and read out of dosimeter displays;
- Safety interlocking system;

3. RESULTS

According to the description of the methodology presented in the previous topic, the IDQBRN inaugurated a laboratory for calibration of gamma ionizing radiation measuring instruments, in a building located on the ground floor of the building that houses the nuclear and radiological defense section, where pre-operational procedures for its licensing are being tested intensively, such as tests for radiation leakage and scattering in the LABCAL and adequacy dosimetry of the sources to the distance square inverse law.

3.1. Efficiency of the installation shield

Measurements performed during the radiometric survey in areas adjacent to the LABCAL have been found to exhibit effective doses values lower than the dose limit established for the public listed in the CNEN Standard NN-3.01, in agreement with calculations performed for the shields. The background in external area is $\text{Hp}(10)=0,18\mu\text{Sv/h}$ and when the sources are exposed the measurements are:

* external area: $\text{Hp}(10)=0,20\mu\text{Sv/h}$

*in front of the door of the irradiator: $\text{Hp}(10)=0,28\mu\text{Sv/h}$

* in the operator position: $\text{Hp}(10)=0,25\mu\text{Sv/h}$

3.2. Calibration of instruments

Ionization chambers and electrometers were calibrated by the National Laboratory of Ionizing Radiation Metrology (IRD) and are being used for measurements of homogeneity and field size (at 1,00 m, 2,00 m and 3,00 m from the source) and for performing the system dosimetry (between 1,00 m, and 3,00 m from the source).

3.3. Laboratory Intercomparison of the Coefficient of Calibration of an Ionization Chamber in Beams of ^{137}Cs and ^{60}Co for Radioprotection Purposes

The event happened from October 2016 to March 2017. It led to the Laboratory Intercomparison of the Coefficient of Calibration of an Ionization Chamber, in beams of ^{137}Cs and ^{60}Co , for radioprotection purposes. The activity involved the laboratories that provide calibration

Figure 2 - Equipment installed in LABCAL
(source: authors)

service for radiation monitors in Brazil. The LABCAL of IDQBRN is getting ready to offer the calibration service soon.. The laboratory that coordinated all the intercomparison activity was the IRD National Laboratory of Ionizing Radiation Metrology (LNMRI).

Interlaboratory comparison is essential to establish the credibility of measurements results, as well as to bring an important collaboration between the involved laboratories. Participation in this type of program is also a requirement enforced by ABNT BR ISO / IEC 17025: 2005.

It was verified that the intercomparison exercise presented an excellent result, demonstrating the competence of the LABCAL in performing calibration services and proving its measurement capacity in practice.

4. CONCLUSION

It is expected that LABCAL will meet increasing demand for calibration of ionizing radiation measuring instruments from specialized organizations of the Brazilian Army, for use in big events and also to supply specific demands from sectors such as health, safety and research.

The implementation of LABCAL will also contribute to increase the availability of Science, Technology and Innovation infrastructure in Brazil and support programs and projects of National Defense interest in the area of application

of nuclear techniques and ionizing radiations in Brazil.

5. REFERENCES

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