Procedures for the ensuring the validity of results in the External Dosimetry Laboratory of Nicaragua ID#171

A.M. Castillo, N.A. Roas, R.E. Pérez, J.S.Mendoza

Laboratorio de Física de Radiaciones y Metrología (LAF-RAM), Facultad de Ciencias e Ingeniería, Universidad Nacional Autónoma de Nicaragua, Managua (UNAN-MANAGUA), Nicaragua

acastillos@unan.edu.ni

1. Background and Goal of the present work

In Nicaragua, the External Dosimetry Laboratory (LDE) is the only one that provides individual monitoring services. It is located at the Radiation Physics and Metrology Laboratory (LAF-RAM). The implementation of the Quality Management System (QMS) based on the reference standard NTN-ISO/IEC17025:2017 began by the end of 2017. The procedure LDE-PT-04 Procedure Ensuring the Validity of Results was elaborated to achieve compliance with the technical requirements of the standard. The purpose of this work is to describe the procedure and the corresponding results at LDE.

2. External Dosimetry Service

2.1 Current situation of the external dosimetry service

The LDE offers the following services with thermoluminescent dosimeters: Dose estimation of whole body in Hp(10), extremity in Hp(0,07) using finger ring dosimeters, eye lens in Hp(3) and estimation of H*(10) for workplace monitoring. The external dosimetry service counts with three TLD readers (RE01, RE02, RE03), one Rados IR-2000 local irradiator of $^{90}Sr/^{90}Y$ and uses thermoluminiscent detectors or dosimeters TLD model RADCARD material MTS-N (LiF:Mg,Ti) for Hp(10), Hp(0,07) and H*(10). For Hp (3) it uses MCP-N. By the first semester of 2022 a total of 149 institutions with 2673 occupational radiation workers were registered in the service.

Figure 1. Equipment of the External Dosimetry Service.

2.2 Trends analysis of quality controls

Methodologies and requirements of the Dosimetry System established for readers parameters such as: reference light counts, dark counts, leakage current, photomultiplier temperature, and readers sensitivity are monitored and checked. These data are plotted over time since 2017 through control charts comparing the trend of the fluctuations of the average values of the measurements between ±2 and ±3 standard deviations.

Figure 2. Example of behaviour of values of reader sensitivity on TLD Reader RE02

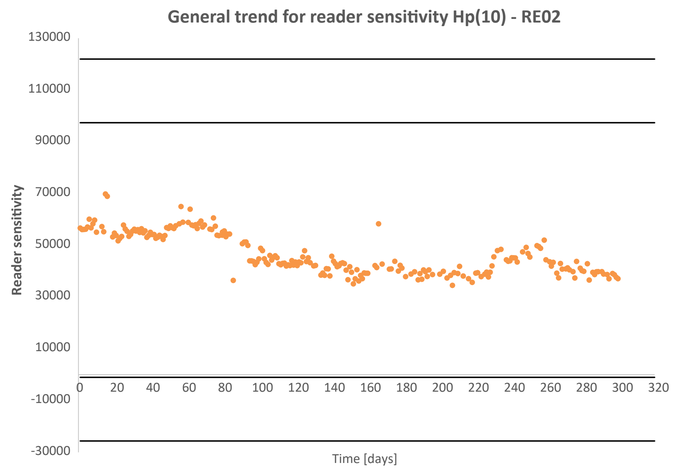
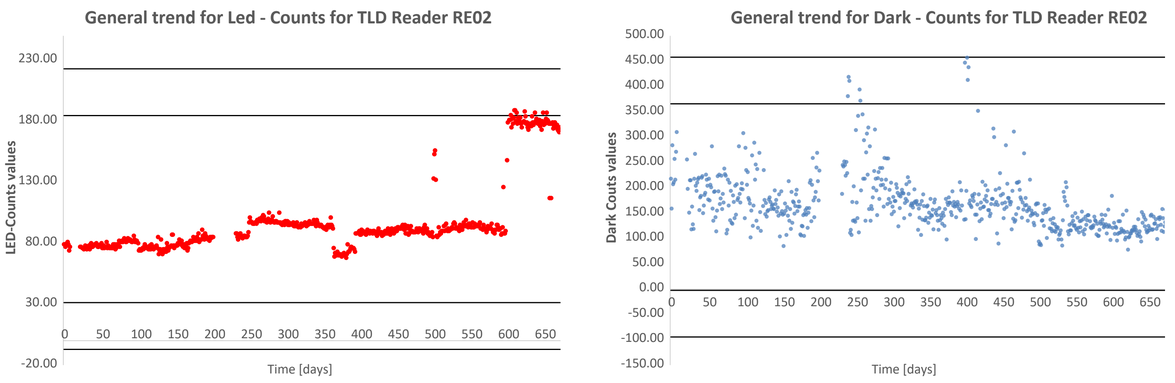


Figure 3. Example of behaviour of values of reference Led counts and Dark counts on TLD Reader RE02



Outliers were observed caused by corrective and preventive maintenance of the equipment. Rise of LED counts after day 600 are due to replacement or spare parts.

Figure 4. Example of behaviour of leakage counts and temperature set on TLD Reader RE02

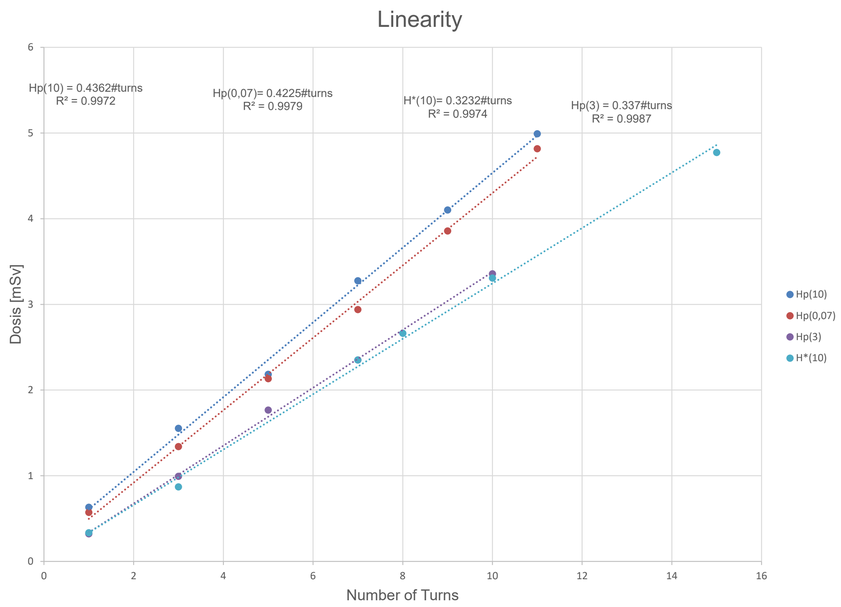
In general leakage counts trend have been keeping the same behaviour over time, no outliers were found. PT temperature control shows high temperature outliers due to air conditioner malfunction then readings cannot be performed.

2.3 Calibration of dosimetry system-traceability

The dosimetry system has been calibrated according to the manufacturer and traceability of calibrations are shown in the following table.

Quantity	Laboratories	Last calibration
Hp(10)	LAF-RAM Laboratory of Calibration Dosimetry (LCD), IAEA, Seibersdorf in May 2019 and last calibration with LMRI of DEN-UFPE of Brazil.	June 2021
H*(10)	LCD and IAEA, Seibersdorf in May 2019	September 2021
Hp(0,07)	LCD and LMRI of DEN-UFPE in Brazil	June 2021
Hp(3)	LCD	June 2020

Figure 5. Verification of linearity in all quantities

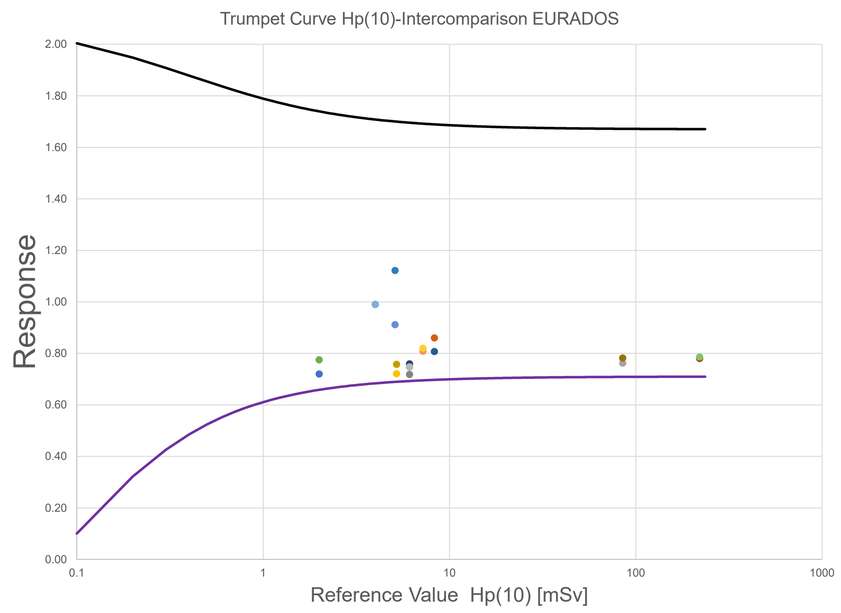


After any calibration the linearity of the system is verified in reference to the local source which performs exposures to the dosimeters (located in a rotating disc) as a function of the number of turns. In all cases linear proportionality was found with coefficients of determination R^2 above 0,95.

2.4 Intercomparison participations

Registered participations with in general satisfactory results: ***a*** the IAEA 2013 intercomparison exercise for whole Body photon dosemeters in Latin America and the Caribbean, through regional project RLA/9/066, ***b*** whole Body photon intercomparison between LCD and Centro de Investigación en Ciencias Atómicas, Nucleares y Moleculares (CICANUM) of University of Costa Rica. As a result of these intercomparisons a recalibration of the system was carried out as an improving action. ***c*** EURADOS whole Body dosimeters intercomparison photon ICph2020 results according to the trumpet curve analysis described in ISO 14146: 2018 are in compliance with the requirements.

Figure 6. Trumpet curve



For W-60°0 and W-60°60 the mean response (R) was 0.82 and 0.99 respectively, W-150°60 mean R was 1.02, SCs-137 and SCo-60 was 0.75 and 0.80 respectively. Mix radiation qualities Cs-137/W-80 the mean R was 0.74

3. Conclusions

General results of procedures and methodologies for ensuring the validity of Results of the External Dosimetry Service in Nicaragua are presented. Nevertheless, as established in the LDE-PT-04 in its Intercomparison Participation Plan, actions to improve the performance, must be taken. For instance, to check the calibration system, since in 95% of the evaluated data the systems underestimate the dose. Calibration, proficiency test and intercomparison are programmed for September 2022.