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ESTIMATION OF MEASUREMENT UNCERTAINTY FOR THERMOLUMINESCENCE DOSIMETRY

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Introduction: The External Dosimetry Laboratory (LDE) of the Center for Radiation Protection and Hygiene (CPHR) carried out a national individual monitoring service based on thermolumincescence dosimetry system. The service has implemented a Quality Management System based on ISO 17015. The papers describe the evaluation of measurement uncertainty associated with the use of TLD dosimetry system in order to comply with ISO requirements. The GUM methodology [1] was appied following quidance of ISO/ASTM 51707:2015(E) standard [2].

Description of the dosimetry system: The individual monitoring service used a RADOS TLD system, with RE-2000 automatic TLD reader. The whole body dosimeters are composed of two LiF:Mg,Cu,P detectors, model GR-200. The system was validated acording type test recommended by ISO/IEC standard and IAEA Safety Guide and m was calibrated for the measurement of Hp(10) for photon radiation.

Methodoly for uncertainty estimation: For estimating uncertainties in measurements we adopted the GUM methodology. Therefore, the components of uncertainty were evaluated as either Type A or Type B uncertainty. The GUM methology included the following steps: (i) definition oh the mensurand (which is the dose) and the mathematic model to calculated the mensurand value from the measurement, (ii) identified the components which contribute to the uncertainty, (iii) quaintified the uncertainties components and (iv) estimation of the uncertainty. The combined standard uncertainty ($\boldsymbol{u_c}$) of the result of a measurement is obtained by combining all the components of uncertainty of both categories.

Results: For Hp(10) we using an ecuation which include: measured value (L), zero dose reading (L_o), detector sensitivity (S_d), system calibration factor (C_d), reader sensitivity (S_L) and natural background dose (F_n). In addition to these elements, we consider other parameters which can affect the results of TLD measurements, such as: energy response and fading. Each parameter were evaluated throught type test during validation and calibration process [3]. Table 1 showed the uncertainty sources identified for our TLD system and the Probability Distribution Function (PDF) assigned to each one.

Table 1. Uncertainty sources for TLD System

Uncertainty source		Type	FDP
Batch homogeneity	(U_L)	A	Normal
Zero dose reading	(U_{Lo})	A	Normal
Detector sensitivity	(U_{Sd})	A	Normal
Calibration	(U_{Cd})	B	Rectangular
Fading	(U_{Kf})	B	Rectangular
Energy response	(U_{Ke})	B	Rectangular
Reader sensitivity	(U_{SL})	B	Rectangular

The values of the contribution of each uncertainty source were calculated based on validation of methods and type test results and combined in cuadrature to obtain the combined standard uncertainty ($\boldsymbol{u_c}$). Them we calculated the expanded uncertainty (***U***) by multiplying $\boldsymbol{u_c}$ by a coverage factor ***k***. For ***k=2*** (two standard deviations), providing about 95 % level of confidence, we obtain a value for ***U=0.18***. The compliance of ICRP´s recommendation on overall accurancy for personal dosimetry were evaluated.

Conclusions: Measurement uncertainty for TLD system were estimated based on GUM methodology. The results showed the compliance of ICPR´s recommendations for individual monitoring service.

References:

1. GUM 1995. JCGM 100. Paris. (2008).
2. ISO/ASTM 51707:2015(E). Geneva. (2015).
3. Pernas, René., Molina, Daniel. *Revista Nucleus*. **37**, (2005).