METHODS IN THERMOLUMINESCENCE DOSIMETRY

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Rigorous statistical procedures have been more and more demanded in any measurement method in order to maximize accuracy and reliability. Thermoluminescence dosimetry (FIG.1) is an extremely indirect measurement and all its measurement uncertainty sources are been studied and correctly evaluated at the Thermoluminescence Dosimetry Laboratory with procedures based on ISO GUM1. The CaSO4:Dy in polytetrafluorethylen matrix pellets has been characterized and classified in relation to its repeatability and reproducibility, the main uncertainty sources in TL metrology. Internal LDT procedures were and are being created or developed to minimize uncertainties, such as the batch formation criterium, based on TL response distribution. The procedure algorithm for dosimeter positioning was developed to minimize uncertainties in environmental dosimetry, and it has been applied at the monitoring reference point. New filter geometry inside the TLD badge is being studied and tested in a master degree program, in order to reduce or eliminate the uncertainty source from the incident radiation angle dependence.

An environmental directional dosimeter patent was submitted and is being analysed by the Brazilian Nuclear Energy Commission (CNEN). An accurate procedure to measure the reference site environmental radiation was developed and implemented. Special TL evaluations were carried out for better radiation detection in a special set-up utilized for biological research, and for an industrial Gammacell irradiator.

FIGURE 1 - Thermoluminescent reader.

THEORETICAL CALIBRATION OF GAMMA SPECTROMETERS USING MONTE CARLO METHOD

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The In Vivo Monitoring Laboratory has been developing theoretical calibrations in order to provide counting efficiency to be used in measurements of gamma emitters internally deposited in the human body. The following occupational monitoring are to be addressed:

- 131I in the thyroid,
- 60Co and 137Cs in the whole body,
- 241Am, 235U, 234Th and 238Pu in lungs and bone.

The studies started in 2000 using experimental standards. For the whole body counting, the Monte Carlo method was used to investigate the dependence of the efficiency on the geometry and density of the standard. For this study an experimental whole body phantom containing known amounts of 57Co, 60Co, 88Y, 133Ba and 134 Cs was first used in order to compare experimental and predicted efficiencies. Then, the behaviour of the efficiency was investigated by simulating the measurements of the reference persons described by the International Commission on Radiological Protection and also by supposing the phantom filled up with water and human tissue. For the thyroid a new mathematical model was proposed to describe the neck region. The variations of the measuring efficiency were evaluated using the international anatomical data and by simulating the measurements of thyroids corresponding to different ages and at different detector neck distances.

During 2003-2004 a new mathematical model for the knee region was developed based on real pieces. Regional atomic data were collected in order to get the regional anatomical behaviour of the dimensions of the bone with the height of the persons. These data were used to investigate the efficiency behaviour as a function of the dimensions of the bones. The behaviour of the counting efficiency as a function of detector positioning in the measurement of thyroid and knee was also investigated within an effort to get a best estimate of the total uncertainties of the measurements.