Medical Physics, Volume 19, No. 6 (1992), Pages 1427–1433

Uncertainty analysis of absorbed dose calculations from thermoluminescence dosimeters

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(Received 22 May 1991; accepted for publication 27 July 1992)

Thermoluminescence dosimeters (TLD) are widely used to verify absorbed doses delivered from radiation therapy beams. Specifically, they are used by the Radiological Physics Center for mailed dosimetry for verification of therapy machine output. The effects of the random experimental uncertainties of various factors on dose calculations from TLD signals are examined, including: fading, dose response nonlinearity, and energy response corrections; reproducibility of TL signal measurements and TLD reader calibration. Individual uncertainties are combined to estimate the total uncertainty due to random fluctuations. The Radiological Physics Center's (RPC) mail out TLD system, utilizing throwaway LiF powder to monitor high-energy photon and electron beam outputs, is analyzed in detail. The technique may also be applicable to other TLD systems. It is shown that statements of $\pm 2\%$ dose uncertainty and $\pm 5\%$ action criterion for TLD dosimetry are reasonable when related to uncertainties in the dose calculations, provided the standard deviation (s.d.) of TL readings is 1.5% or better.

INDEXING TERMS: THERMOLUMINESCENT DOSEMETERS, RADIATION DOSES, CALIBRATION, NONLINEAR PROBLEMS, RADIOTHERAPY, ELECTRON BEAMS, PHOTON BEAMS, BEAM MONITORING, ACCURACY