

# Uncertainties in workplace external dosimetry

## A Monte Carlo approach

J.W.E. van Dijk  
NRG Radiation & Environment, Arnhem, The Netherlands

### Abstract

The measurement of personal dose equivalent with a personal dosimeter involves measuring or estimating of a number of values. These values, input quantities, are used to calculate the dose, output quantity. The measurements or estimations of the input quantities contribute with their uncertainties to the uncertainty in the output quantity, the dose. The ISO Guide to the expression of uncertainty in measurement<sup>(1)</sup> (GUM) gives guidance on how to evaluate the uncertainty in the output quantity. This most commonly involves the application of the law of propagation of uncertainty (LPU). For evaluating the uncertainty in measurements with personal dosimeters, like TLD or film dosimeters, compliance with the requirements for the LPU is not trivial at all.

Evaluating a dose using a TLD-reader or a film densitometer involves in many cases highly non-linear or even discontinuous functions. For example the ratio of the signal of two differently filtered TLDs, which is often used for applying energy correction, shows a sharp bend between 20 and 50 keV. This sharp bend, together with the uncertainties in the signal of the two detectors, makes application of the LPU questionable. The use of numerical methods based on Monte Carlo techniques can overcome these problems. Guidance for this approach has recently been given in the first supplement on the GUM<sup>(2)</sup>. The current paper demonstrates the numerical approach for a one and a two element TL-dosimeter and compares the results with the approach recommended in the EC Technical Recommendations<sup>(3)</sup>.

1. International Organization for Standardization. *Guide to the expression of uncertainty in measurement*, Supported by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML (Geneva: ISO) (1995).
2. International Organization for Standardization. *Guide to the expression of uncertainty in measurement (GUM)- Supplement 1: Numerical methods for the propagation of distributions*. ISO Draft Guide DGUIDE99998 (Geneva: ISO) (2004).
3. European Commission. Christensen P., Julius H.W. and Marshall T.O. *Technical recommendations for monitoring individuals occupationally exposed to external radiation*. Report EUR 14852 EN, Radiation Protection **73** (1994).

Alternative for the title:

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