RAP 2023

INTERNATIONAL CONFERENCE ON RADIATION APPLICATIONS

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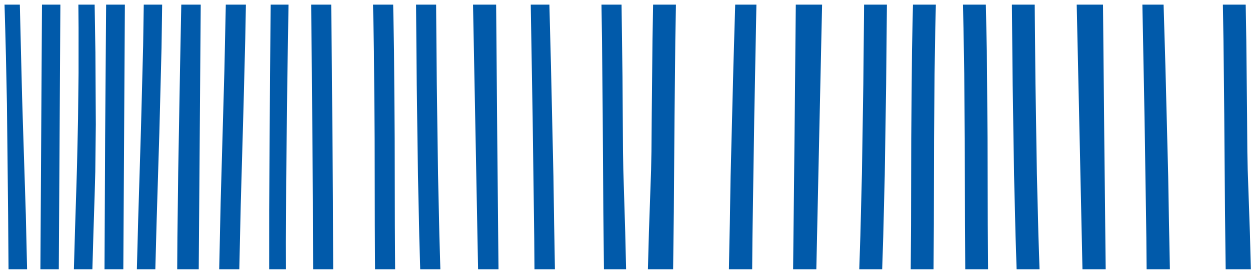
BOOK OF ABSTRACTS



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LiF:Mg,Ti TLD angular dependence evaluation at low energy incident radiation

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Accuracy of measurement in individual dosimetry monitoring service is achieved by performing calibration of dosemeters, ensuring that the measured values are traceable to the primary standard for the quantity of interest. Even though a dosemeter can exhibit remarkable performance in the reference calibration radiation field (e.g. ^{137}Cs), its performance can greatly differ under certain conditions. Effects of different influence quantities need to be examined to ensure that the dosemeters are reliable for use in a specific ionizing radiation practice. The most significant radiation characteristic influence quantities are the radiation energy, angle of incidence and dose (rate). International standards issued by IEC and ISO define radiation conditions and procedures for dosemeter type testing under effects of different radiation, environmental and mechanical influence quantities. Dosemeter performance is expressed in terms of relative response and is evaluated by comparing with defined limits of variation, taking into account the measurement uncertainty, according to [IEC 62387:2020, IEC, 2020].

A passive dosimetry system based on LiF:Mg,Ti thermoluminescent dosemeters (TLD) was tested for the effects of photon energy and angle of incidence in two dosemeter orientations, horizontal (up/down) and vertical (left/right), for the measurement of personal dose equivalent ($H_p(10)$ and $H_p(0.07)$). The dosemeters were read out on the Harshaw TLD™ Model 6600 Plus Automated Reader (Thermo Fisher Scientific, USA), calibrated in ^{137}Cs reference field. Low-energy X-ray reference field N-40, established according to ISO 4037-1:2019 [ISO 4037, ISO, 2019] and ±45°, ±60° angles of incidence were used to examine the passive dosimetry system performance. Limits of variation from -29 % to +67 %, defined in [IEC 62387:2020, IEC, 2020] for energy and angular relative response, were used for performance evaluation.

The overresponses for $H_p(10)$ for 45° and 60° were (51 – 62) % and (76 – 88) %, respectively. The results for $H_p(0.07)$ for 45° and 60° were (66 – 69) % and (79 – 95) %, respectively. Thus, for both quantities it was observed that the criteria are met for the angle of ±45°, while for ±60° neither comply with the standard, for both dosemeter orientations, when uncertainties are taken into account.

This shows that tested TLD system has high overresponse in low energy photon fields when larger angle of incidence values is encountered. The response could be improved if dosemeters are calibrated using appropriate reference calibration field or if different dosemeter holder is employed.

Keywords: individual monitoring, $H_p(10)$, $H_p(0.07)$, external radiation dosimetry

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