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Calibration and verification of dosimeters for high energy electron and photon radiation at METAS 22 MeV accelerator

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1 Introduction

Therapy dosimeters for high-energy photon and electron radiation have to be verified every four years by METAS. The verification consists of a general test of the equipment, the determination of the reference value of the check-source and, most essentially, the actual calibration of the dosimeter (in following device under test, DuT).
METAS has two different calibration methods available:

1. Using Co-60 radiation and applying pre-determined constants to calculate the calibration factors (kQ model) for the various beam qualities used in hospitals.
2. Direct comparison of DuT with a secondary standard in high energy electron or photon field of the 22 MeV electron accelerator. Since the accelerator has more than eight different photon and electron beam qualities available, DuTs can be calibrated at beam qualities very similar to those used in hospitals.

In the past, most calibrations were performed with Co-60 for efficiency reasons. However, recent progress in the accelerator performance now allows for very efficient calibration in accelerator beam. Moreover, a new measuring station was developed which will be presented here.

2 Materials and Methods

METAS operates a flexible 22 MeV Microtron-type electron accelerator for calibration and research purpose. It is equipped with a conventional treatment head. It serves as a source for clinical electron beams (R50 = 1.75 to 8.54g/cm2) and photon beams (TPR20,10 = 0.639 to 0.789), respectively.
The comparison between the secondary standard and the customer's device (DuT) is done indirectly via a set of two monitor chambers: the calibration procedure sequentially irradiates either the secondary standard or one DuT, whereas the two monitor chambers are used for the normalization. A new software that also monitors environmental parameters and regularly checks the accelerator status manages this sequence in an automated way. In addition, the software is connected to a database containing all the relevant measurement data and parameters. It also keeps track of the measurement devices and their calibration certificates.

3 Results

The new calibration station at METAS' accelerator substantially simplifies the calibration process and it enables ionization chambers to be calibrated as efficiently as in Co-60. The new measuring station was validated by comparing several secondary standards. Good agreement was found to the results obtained during the last primary campaign.

4 Conclusions

The new calibration station enables an efficient service for the calibration of therapy dosimeters directly in high-energy electron and photon radiation but with reduced uncertainty compared to the method in Co-60. It is foreseen that this service will be offered to the verification customers in future.

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