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THE METAS ABSORBED DOSE TO WATER CALIBRATION SERVICE FOR HIGH ENERGY PHOTON AND ELECTRON BEAM RADIOTHERAPY

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The Swiss Federal Office of Metrology and Accreditation (METAS) provides an absorbed dose to water calibration service for reference dosimeters using ^{60}Co γ radiation, ten X-ray beam qualities between $TPR_{20,10}$ = 0.639 and 0.802 and ten electron beam qualities between R_{50} = 1.75 gcm^{-2} and 8.54 gcm^{-2}. A 22 MeV microtron accelerator with a conventional treatment head is used as radiation source for the high energy photon and electron beams. The treatment head produces clinical beams.
The METAS absorbed dose calibration service for high energy photons is based on a primary standard sealed water calorimeter of the Domen type [1], that is used to calibrate several METAS transfer standards of type NE2611A and NE2571A in terms of absorbed dose to water in the energy range from ^{60}Co to $TPR_{20,10}$ = 0.802. User reference dosimeters are compared with the transfer standards to give calibration factors in absorbed dose to water with an uncertainty of 1.0% for ^{60}Co γ radiation and 1.4% for higher energies (coverage factor k = 2). The calibration service was launched in 1997. The calibration factors measured by METAS have been compared with those derived from the Code of Practice of the International Atomic Energy Agency [2] using the calculated k_Q factors listed in [2], table 14. The comparison showed a maximum difference of 0.8% for the NE25611A and NE 2571A chambers. At ^{60}Co γ radiation the METAS primary standard of absorbed dose to water was bilaterally compared with the primary standards of the Bureau International des Poids et Mesures BIPM (Sèvres) [3] as well as of the National Research Council NRC (Canada) [1]. In either case the standards were in agreement within the comparison uncertainties.

The METAS absorbed dose calibration service for high energy electron beams is based on a primary standard chemical dosimeter. A monoenergetic electron beam of precisely known particle energy and beam charge is totally absorbed in Fricke solution (ferrous ammonium sulphate) of a given mass. This experiment is similar to the one described by Feist [4], but extended to an energy range from 5.3 MeV to 22.4 MeV, allowing to determine the energy dependence of the response of the Fricke dosimeter. The absorbed dose to Fricke solution is determined using the particle energy, the total beam charge and the mass of the solution. The absorbed dose to Fricke solution is converted to an absorbed dose to water applying a general conversion factor taken from Ma et al. [5]. The thus calibrated Fricke solution is then used to calibrate several METAS plane-parallel transfer ionisation chambers of type NACP-02 in the mentioned energy range. The user dosimeters are finally compared to the METAS transfer standards following the procedures described in [2]. It is anticipated that the overall uncertainty in the calibration factor of a user dosimeter will be around 2% (coverage factor k =2).

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