Energy dependence study of Radcal ionization chambers in standard diagnostic X-ray beams

A. C. M. Bessa, L. V. E. Caldas

Instituto de Pesquisas Energéticas e Nucleares (IPEN), Comissão Nacional de Energia Nuclear (CNEN), Av. Prof. Lineu Prestes, 2242, 05508-000, São Paulo, SP, Brazil

According to international recommendations, ionization chambers used in beam monitoring and beam dosimetry, at diagnostic radiology level, shall be calibrated periodically. Since the calibration of these instruments is an important factor affecting the radiological protection quality assurance programs, this work presents an ionization chamber intercomparison in standard diagnostic X-ray beams, using the calibration coefficients of the instruments as a comparison factor. Response energy dependence curves were obtained for the ionization chambers too.

The reference instrument used for the measurements of the air kerma rates was a PTW ionization chamber, type 77334, coupled to a PTW electrometer, model Unidos. This ionization chamber was calibrated at the German Primary Standard Dosimetry Laboratory, the Physikalisch-Technische Bundesanstalt (PTB). The standard diagnostic X-ray beams used in this work were recommended by IEC 61267 [1]. These standard beams enclose an energy range from 25 keV to 82 keV. The beams were established at a Seifert/Pantak X-ray system, model ISOVOLT 160HS. For the monitoring of the intensity variations of the X-ray beams during the calibrations, a PTW transmission ionization chamber, model TW34014, coupled to a PTW electrometer, model Unidos E, was utilized. Twenty-one Radcal ionization chambers were tested, models 10x5-180, 10x5-60, 10x5-6 e 10x5-6M.

The ionization chamber, model 10x5-180, showed the lowest energy dependency: 4.1%. The chambers, models 10x5-60 and 10x5-6, presented 4.3% and 5.5% of maximum energy dependence, respectively. The chamber that showed the highest energy dependence was that of model 10x5-6M: 8%. Two chambers of model 10x5-6M presented a value of energy dependence higher than that recommended by the IEC 61674 [2]; this fact occurred probably because this kind of chamber (model 10x5-6M) was designed for use in mammographic beams, that present lower energies than the energies of conventional diagnostic X-ray beams used in this work.

In agreement with the requirements of the IEC 61674 [2], eighteen chambers showed a maximum value of energy dependence lower than 5%.

References

[1] INTERNATIONAL ELECTROTECHNICAL COMMISSION. Medical Diagnostic X-Ray Equipment - Radiation Conditions for Use in Determination of Characteristics. Geneva, 1994. (IEC 61267).

[2] INTERNATIONAL ELECTROTECHNICAL COMMISSION. Medical Electrical Equipment. Dosemeters with Ionization Chambers and/or Semi-Conductor Detectors as used in X-ray Diagnostic Imaging. Geneva, 1997. (IEC 61674).

E-mail: acmbessa@ipen.br / lcaldas@ipen.br