AbstractID: 8317 Title: Analysis of dose perturbation factors for an NACP-02 parallel-plate ionization chamber in clinical electron beams

Purpose: To investigate the dose perturbation factors p_{wall}, p_{cav}, p_Q in water of an NACP-02 parallel-plate ionization chamber in clinical electron beams (4-18 MeV). These perturbations factors are assumed unity in current dosimetry protocols, but recent publications have cast doubts on this.

Method and Materials: An EGSnrc Monte Carlo model was developed for the NACP-02 parallel-plate ionization chamber. Perturbation factors for the presence of the non-water wall p_{wall}, the presence of an air cavity p_{cav} and the total perturbation factor p_Q were calculated in water. The influence of the front and back walls were investigated. The influence of electron beam energy and depth in water were investigated.

Results: p_{wall} is significantly different from unity for low energy electron beams, and decreases with energy. p_{cav} is close to unity for all beam energies. Both p_{wall} and p_{cav} increase significantly with depth in water, leading to an increasing p_Q, which reaches a value of 1.23 at a depth of R_{50} for 4 MeV electrons. This was, however, found to depend strongly on whether scaling of the non-water equivalent front wall of the chamber was performed; p_Q decreased from 1.23 to 1.02 for 4 MeV electrons at R_{50} when scaling is done. At the reference depth z_{ref}, little effect of the window scaling was noted. The back and front wall of the ion chamber were found to have opposite influences on p_{wall}. The effect of in-scattering and track obliquity on the depth dependence of p_{cav} was investigated.

Conclusion: The findings of an increased p_Q with depth in water could have important consequences for clinical depth dose measurements. However, the issue of front window scaling needs further study, and recommendations need to be issued. The behaviour of p_{cav} and p_{wall} with depth and energy were explained. Studies like these may allow improved chamber design.