AbstractID: 2830 Title: Perturbation factors for the plane-parallel NACP02 ionisation chamber in electron beams

Purpose: To calculate perturbation factors, p_{wall} and p_{cav}, for plane-parallel ion chambers in electron beams, and to investigate their origin.

Method and Materials: Current dosimetry protocols for clinical electron beams (AAPM, IAEA, IPEM) recommend the use of plane-parallel ion chambers, such as the NACP-02. These protocols describe how dose–to-water calibration factors, $N_{D,w}$, are used to derive dose to water from ionization measurements in water or plastic phantoms. These factors implicitly include chamber perturbation factors for the non-medium equivalence of the chamber walls and cavity material, p_{wall} and p_{cav}. The perturbation factors are currently assumed unity for well-guarded plane-parallel ion chambers. In this work we have used the Monte Carlo (MC) code EGSnrc to calculate perturbation factors in water, plastics and graphite (used in standard labs) for electron beams ranging from 4-20 MeV for the NACP-02 ion chamber. The MC model was first validated against measurements of chamber response in a solid slab phantom where thin slabs of different materials (plastics, Al, Cu) could be brought in close contact with the ion chamber. In addition, stopping power ratios, medium-to-air, were calculated for clinical and calibration electron beams.

Results: The agreement between calculated and measured ion chamber response in the slab phantoms was within 1%. Cavity perturbation factors, p_{cav}, for the NACP-02 chamber were found to be within 1% of unity within statistical uncertainty (0.2%). Wall perturbation factors, p_{wall}, for the energy range 4-20 MeV were found to vary from (1.7±0.2)% to (0.2±0.2)% for the NACP-02 chamber. Stopping powers, water-to-air, were found to differ by up to 0.5% from the currently recommended values (Burns et al 1996).

Conclusion: Electron perturbation factors for the NACP-02 plane-parallel ion chamber were found to differ significantly from unity, which is the currently assumed value.