AbstractID: 3642 Title: Influence of ion chamber response on in-air profile measurements in megavoltage photon beams

Purpose: To investigate the influence of the ion chamber response including build-up cap materials, on the measurements of in-air off-axis ratio (OAR) profiles in megavoltage photon beams using Monte Carlo (MC) stimulations with the EGSnrc system.

Method and Materials: Two new techniques were developed for the calculations of OARs when the ion chamber is oriented horizontally or vertically. For a horizontally oriented chamber pre-calculated tables of the response of an ion chamber inserted in a build-up cap for different photon energies was used to compute the dose deposited in the air cavity on-the-fly within the BEAMnrc simulation. For a vertically oriented chamber the BEAMnrc code was modified so that it can be compiled into a shared library that serves as a particle source for the CAVRZnrc user code. With these BEAMnrc and CAVRZnrc changes the OAR could be calculated on the fly without intermediate phase-space file generation. Results of the simulations were compared with experimental profiles from the 6, 10 25 MV photon beams from an Elekta Precise linac.

Results: The calculated and measured in-air profiles for all investigated beams and build-up caps (brass, hevimet and two PMMA miniphantoms) are in a good agreement within the statistical and experimental uncertainties. The comparison between the calculated air-kerma and OAR profiles shows 3-6% differences between air-kerma and in-air profiles measured with hevimet and brass caps and 0.5-1% differences for measurements with PMMA mini-phantoms.

Conclusion: The change of chamber response with distance from the central axis must be taken into account. For in-air profiles measurements PMMA mini-phantoms should be recommended over high-Z material build-up caps.