AbstractID: 13001 Title: On Monte Carlo Modeling of Megavoltage Photon Beams: A Revisited Study on Beam Parameters Sensitivity

Purpose: To commission Monte Carlo beam models for 5 Varian megavoltage photon beams (4, 6, 10, 15 and 18 MV). The goal is to match measured dose distributions in a water phantom within 1% local difference for a wide range of field sizes. Another objective is to re-investigate the sensitivity of dose distributions to the primary electron beam parameters.

Material and Methods: The GEPTS Monte Carlo code is used for photon beam simulation and dose calculations. Linac geometry models are based on (i) manufacturer specifications, (ii) corrections made by Chibani and Ma (Med. Phys. Vol. 34, 2007), and (iii) recent drawings of the W/Pb shields. Measurements were performed using pinpoint and Farmer ionization chambers depending on the field size. In addition to the three commonly used primary electron beam parameters (E_{AV}: average energy, FWHM: energy spectrum broadening, and R: beam radius), we also included the primary electron angular divergence (θ).

Results: We were able to match within 1% local difference measured depth dose distributions and lateral dose profiles (within 1%/1mm in penumbra), at any depth beyond 1 cm. Varying primary beam parameters away from the solution can lead to 5% differences with measurements for small (e.g. 2×2 cm^2) and large (e.g. 35×35 cm^2) field size WHILE a perfect agreement still stands for 10×10. Very small and very large field sizes prove to be more sensitive to FWHM, R and θ variations than the 10×10 field size.

Conclusion: GEPTS beam models reproduce measured dose distributions within 1% local difference and simultaneously for field sizes varying from 2×2 to 35×35. Achieving 1% agreement between measured and calculated dose distributions for the 10×10 field size is relatively easy. However, this does not guaranty a similar agreement for other field sizes. Therefore, Monte Carlo beam models need to be commissioned for multiple field sizes.