AbstractID: 3500 Title: Influence of Initial Pencil Beam Parameters on Large Non-Applicator Electron Field Profiles Calculated Using Monte Carlo Methods

Purpose: To investigate the influence of the initial pencil beam width on large non-applicator electron field profiles calculated using the BEAMnrc/EGSnrc Monte Carlo code. For a Varian 2100C linear accelerator, significant discrepancies of up to 10% in the shoulder of the profile were found between measured and calculated profiles for 40x40 cm^2 electron fields collimated using x-ray jaws alone, when using the standard electron spot size of 1.5 mm. A small angular variance of the electron pencil-beam at the x-ray target would be equivalent to increasing the electron pencil-beam spot size at the primary scattering foil, which would be expected to affect the electron fluence profile exiting the linear accelerator.

Method and Materials: Cross-beam profiles at the depth of maximum central-axis dose were measured and calculated for electron beams with a field size of 40x40 cm^2 collimated by the x-ray jaws without an electron applicator. The electron spot size at the position of the x-ray target was modeled as a mono-energetic mono-directional Gaussian with a full-width half-maximum (FWHM) that varied from 1.5 to 5 mm. For each energy, measured and calculated profiles were compared to determine the optimal FWHM.

Results: Adjusting the FWHM of the source greatly affected the shoulder of the calculated off-axis profiles, reducing discrepancies to ±4%. The optimal FWHM ranged 2.5 to 4.5 mm and was energy dependent. Assuming that the correct spot size at the x-ray target is 1.5 mm, this is equivalent to an angular spread at the x-ray target of 8.8 to 20.9 mrad.

Conclusion: The angular spread of the electron pencil-beam at the x-ray target is significant and varies with energy, mostly influencing the shoulders of large non-applicator electron field profiles. The effect of the initial angular spread on other dosimetric data will be the subject of future investigations.