AbstractID: 5001 Title: Inter-linac and intra-linac variability of x-ray and electron dose distributions

Purpose: To determine the maximum expected variation in fluence, differential in energy and position, with an accuracy of 1% for a single linac model, and eventually, combining with Monte Carlo beam models, to develop gold standard beam model benchmarks.

Method and Materials: The 6 and 18 MV beams of the Siemens Primus linear accelerator (linac) were tuned through the manufacturer acceptance range in field flatness by adjusting beam energy. Dose profiles were measured at the low, high and average energy in this range for small, medium and large field sizes to quantify the intra-linac variations caused by energy adjustment. The 6 and 18 MV x-ray beams, and 6-21 MeV electron beams on three Primus machines, with the same treatment head, were tuned to give the same central axis depth dose curves to better than 0.5% for the largest fields available: 40x40 cm for photons, and 25x25 cm for electrons. Profiles were measured on these linacs to investigate the inter-linac variations.

Results: For the intra-linac variations, the energy tuning has the largest effect of 7% at 10 cm on beam penetration for small fields. Scattering in the field reduces this effect for larger fields. Wedged-field profiles are affected more than the open field, due to the dependence of transmission on energy. For inter-linac variation, profiles measured from three different machines vary more than 2% due to beam tuning differences, lateral displacement of flatteners or scattering foils, and differences in position of components relative to the source.

Conclusion: The range of inter-linac and intra-linac variability has been measured on a Primus linac and is clinically significant. This data will be used with Monte Carlo treatment head simulation to calculate gold standard beam model benchmarks for the development of tunable beam models of high accuracy and detail in the dose-critical components of fluence.