Purpose: To validate the AcurosXB dose calculation algorithm for small field dosimetry for high energy photon beams.

Methods: Calculations in water phantom of 0.2x0.2x0.2cm³ voxel size with slabs of inhomogeneity materials (air rho=0.0012g/cm³, lung rho =0.2 g/cm³ and bone rho =1.85 g/cm³) were used in this study. Fields sizes ranging from 1x1cm² to 10x10cm² and energies of 6, 10 and 18MV were calculated using the Acuros XB dose calculation algorithm available in the Eclipse treatment planning system (TPS). The calculations were compared to the Analytical Anisotropic Algorithm (AAA) also available in Eclipse as well to Collapsed Cone Convolution Superposition (CCCS) algorithm available in the Pinnacle3 TPS. Comparison between the dose calculations and Monte Carlo calculations using EGSnrc\BEAMnrc and EGSnrc\DOSXYZnrc package was also performed.

Results: The AcurosXB calculation algorithm was in general in good agreement with Monte Carlo calculations. Discrepancies were observed at the interfaces of the inhomogeneities. Good agreement between CCCS and AcurosXB was also observed for the majority of the cases with discrepancies observed only at the interfaces of the media. The AAA did not successfully calculate the dose for the test geometries when small fields were used. Discrepancies in the order of 50-70% were observed. The AAA overestimated the dose in the low density material and failed to predict the second buildup region accurately for the very small field sizes.

Conclusion: In general, the overall degree of accuracy for AcurosXB in the conditions of electronic disequilibrium was in good agreement with Monte Carlo calculations (within 2%) and comparable with the CCCS algorithm. The AAA on the other hand failed to accurately predict the dose for the small fields studied in the presence of inhomogeneities