

ABSTRACT

Significant discrepancies between Monte Carlo dose calculations and measurements for the Varian 18 MV photon beam with a large field size ($40 \times 40 \text{ cm}^2$) were reported by different investigators. The GEPTS Monte Carlo code is used to investigate these discrepancies and a new geometry model (New Model) of the Varian 2100EX linac is implemented. A misrepresentation of some geometric parameters in previous investigations (Old Model) was suggested by Chibani in his AAPM presentation (2004) and later confirmed by the manufacturer. The entrance and exit radii of the primary collimator are 2-mm larger than previously thought. The primary collimator is also found to be 2-mm shorter and 1-mm closer to the target. The New Model also includes the lead shield between the monitor chamber and the Y jaws. A detailed analysis of the phase space data (before and after the primary collimator, after the flattening filter, and at the phantom surface) shows the effect of the changes introduced in the New Model on the beam characteristics (photons and electrons). The main source of the dose discrepancies between measurements and calculations based on the Old Model is the underestimated electron contamination. The photon and electron fluences at isocenter are 4.7% and 30% larger in the New Model in comparison with the Old Model. The flattening filter and lead shield contribute 50% and 10.1% of the total electron contamination at isocenter, respectively. Dose calculations based on the GEPTS implementation of the New Model for the 18 MV open and filtered (2-mm Pb foil) fields are in excellent agreement with measurements. Local differences are less than 1.5% for depths larger than 1 cm. Monte Carlo simulation of the ionization chamber response shows that difference between calculated and measured percent depth ionizations can be reduced to less than 3% even on the surface.