AbstractID: 13005 Title: Dose Response of MD-55, EBT and EBT-2 Radiochromic Films: A Monte Carlo Study

Purpose: To calculate the film dose response using Monte Carlo simulation of photon/electron transport. The film dose response (dose in film versus dose in water) is calculated for brachytherapy sources (^{103}Pd, ^{125}I, ^{192}Ir and ^{137}Cs) and megavoltage photons beams (^{60}Co, 6 MV and 18 MV). Effects of the film composition and source-film distance on the film response are also investigated.

Material and Methods: The GEPTS code is used for dose calculations in radiochromic films. The detailed film structure including the film base, the adhesive, the surface layer, and the active layer is simulated. The elemental compositions of these layers are provided by the manufacturer. Photons and electrons are transported down to 1 keV. The GEPTS photoionization and atomic relaxation processes are based on the latest EPDL97 cross section database.

Results: The film response is very sensitive to variations of the elemental composition of the active layer. Up to 100% differences are seen between MD-55, EBT and EBT-2. For a given film, variations in Cl, K and Br (which contents are normally below 0.3%) can have major effects on the film response for barchytherapy sources (e.g. ^{103}Pd, ^{125}I and ^{192}Ir). Increased source-film distance can lead to non-negligible variations of the dose response because of energy spectrum hardening (e.g. 3% for ^{103}Pd at 8 cm versus 2 cm from the film). For ^{60}Co, 6 MV and 18 MV beams, the film dose response is very close to unity even in the buildup region.

Conclusion: Although the energy deposited in film is not simply related to the measured optical density, it is nevertheless important to understand how it compares with the dose in water for different energies and irradiation setups. Present calculations are the first step towards a more comprehensive study involving the chemistry and physics of radiochromic films (e.g. percolation theory).