AbstractID: 13263 Title: Variations in 6MV Photon Energy Spectra Impact the Response of TLD

Purpose: TLD exhibits a response that is dependent on photon energy; however, the specific energy response is typically determined only for the photon spectrum at the standard dose calibration point (depth of maximum dose on central axis from a 10cmx10cm field). Variations in the energy spectra as a result of field size, measurement location, or the presence of heterogeneities have not been previously considered. Therefore, we sought to quantify these variations from a 6-MV beam, as well as to characterize the corresponding changes in energy response of thermoluminescent dosimeters (TLD).

Method and Materials: Photon energy spectra from a 6MV beam were simulated at various locations throughout a water tank using Monte Carlo. This was done for fields sizes ranging from 5cmx5cm to 20cmx20cm, and for locations up to 20cm deep and 50cm from the central axis. We also calculated the spectra with the addition of 9cm of bone and lung material. The range of calculated energy spectra were then used to determine theoretical energy correction factors of TLD through the application of Burlin cavity theory.

Results: The photon energy spectrum varied with location and field size, and was most substantially different outside of the treatment field. The presence of heterogeneities had little impact on the spectrum. Correspondingly, within the treatment field, as well as in the presence of heterogeneities, there was only a small perturbation to the dose measurement of the TLD (<1%). The most substantial energy response was for dose measurement outside of the treatment field, which varied up to 8% relative to the central axis calibration location.

Conclusion: Variations in photon energy spectrum do not greatly impact the TLD response under most in-field conditions. A single additional energy correction factor of 0.95 should be applied to out-of-field measurements using TLD to correct for changes in photon energy spectra.