

## AbstractID: 7253 Title: Neutron Dose Equivalent at Depth in a Phantom

**Purpose:** Neutrons are a byproduct of high-energy radiotherapy. Although these neutrons have been studied thoroughly in air, little work has been done to study these neutrons at depth in the patient. This study evaluates the fluence, energy, and average quality factor of neutrons as a function of depth in water.

**Method and Materials:** MCNPX was used to develop a Monte Carlo model of a Varian 2100 accelerator operated at 18-MV. This model was used to calculate the neutron fluence and energy spectra in air and at depths in water between 0.5cm and 19.5cm. The quality factor was also determined, based on the calculated spectrum and mono-energetic quality factors and kerma factors.

**Results:** Compared to the fluence in air, the presence of a phantom led to an increase in the fluence due to increased scatter. At increasing depth in the phantom, the fluence remained nearly constant until a depth of 3.5 cm and then decreased at deeper depths. The average neutron energy decreased until approximately 7.5 cm depth and then remained nearly constant at deeper depths. The quality factor decreased from 16.7 (at 0.5 cm depth) to 13.9 at (19.5 cm depth). The percent depth dose equivalent curve generated by the neutron spectra produced by a medical accelerator was found to be different from a previously published percent depth dose equivalent curve generated by mono-energetic neutrons of the same average energy. Using mono-energetic neutrons overestimated the dose equivalent by up to 20% and underestimated the dose equivalent by up to a factor of 3 at deep depths.

**Conclusion:** The neutron fluence and spectrum changed substantially with depth, as did the neutron quality factor. Therefore, when the neutron dose equivalent in a patient is being evaluated, it is necessary to evaluate the neutron spectrum and quality factor at the relevant depth.