AbstractID: 5183 Title: Monte Carlo Based Simulation and Analysis of SRS X-ray 6 MV Beam Tenth-Value-Layer Data for Common Shielding Materials

Treatment room shielding design depends on barrier attenuation data. It is common practice to use tenth-value-layers (TVLs) or related quantities measured for a given beam quality and shielding material. This investigation has applied Monte Carlo simulation to accurately determine the first, second and third TVLs for the three most common building materials: ordinary concrete, lead, and steel (iron). The radiation beam is 6 MV x-rays coming from a robotically mounted stereotactic radiosurgery (SRS) accelerator which has a maximum field diameter of 6 cm at 80 cm from the target. The first three TVLs are presented for a range of field sizes up to the broad beam equivalent of a 40 cm by 40 cm field at 1 m. The x-ray spectrum used to perform these simulations was generated for the CyberKnife^{TM} accelerator with the BEAMnrc Monte Carlo code. This spectrum was used as input to the MCNP5 Monte Carlo code, to predicted tissue-maximum-ratio (TMR) values for a 6 cm diameter field (at 80 cm from the target) and benchmarked against measured TMR data. The MCNP5 code was used to simulate all barrier transmission factors, keeping the standard error of each data point below 1% of the mean. The results show that SRS TVLs change rapidly with the diameter of the radiation field incident on the barrier (with a slower rate of increase above about 15 cm diameter). Also analyzed were the characteristics of TVLs (specifically, the ordering TVL_1, TVL_2, and TVL_3) as a function of field diameter at the barrier for all materials, with special attention given to the TVL properties in iron. The TVL results compare very well with previously measured concrete TVLs for the SRS machine and, also, with published broad-beam 6 MV TVL data for all three barrier materials.