AbstractID: 9287 Title: Energy Spectrum Based Calculation of the Half and the Tenth Value Layers for Brachytherapy Sources Using a Semi-Empirical Parameterized Mass Attenuation Coefficient Formulism

Purpose: Using a semi-empirical parameterized mass attenuation coefficient formulism to establish a relatively straightforward energy-spectrum-based method for the calculations of Nth Value Layer of various brachytherapy sources. **Method and Materials**: A semi-empirical parameterized mass attenuation coefficient formulism has been established by Orlic et al for any single-element material (Z<93) and for photon energies between 0.1 keV and 1000 MeV. This formulism is applied to establish an energy spectrum based framework for the calculations of Nth Value Layer of any single-element material (Z<93) for photon emitting radionuclides and clinical brachy sources which energy spectra are known and fall in the energy range. In principle, this framework can be used to derive any order of HVL or TVL of any single-element material. Calculations were performed for 17 types of radionuclides and brachy sources, and for materials of lead, copper and iron. **Results:** The 1^{st} HVLs and TVLs in lead, copper and iron were calculated and tabulated for 17 types of radionuclides and brachy sources, based on their known energy spectra. The corresponding HVLs and TVLs were also computed based on the average energies of these radionuclides and sources. To demonstrate the importance of energy-spectrum-based formulism, the 1^{st} to 11^{th} TVLs were calculated as well. It was found that the average-energy-based approach tend to underestimate values of HVL and TVL for most of the radionuclides and sources. As expected, except for mono-energetic sources, the TVL tends to increase with attenuation (e.g., 2^{nd} TVL > 1^{st} TVL). The value of the equilibrium TVL may be significantly higher than the 1^{st} TVL. **Conclusions**: A simple energy-spectrum-based method has been established for the determination of the N^{th}VL value for brachytherapy sources. It was also found that the average energy based formulism may likely underestimate the values of the HVL and TVL for clinical brachy sources.