AbstractID: 6963 Title: Calculating the Air-Kerma Strength and Dose-Rate Constant of ¹²⁵I and ¹⁰³Pd Low Dose Rate Brachytherapy Sources Using Spectra Measured With a High-Purity Germanium Spectrometer

Purpose: To calculate spectroscopic analogs of the air-kerma strength and dose-rate constant using the fully corrected energy spectra of ^{125}I and ^{103}Pd low dose-rate (LDR) brachytherapy sources measured with a high-purity germanium (HPGe) spectrometer.

Methods and Materials: A high-purity germanium spectrometer (CANBERRA, GR2519), driven by CANBERRA Genie2000™ gamma analysis software, was used to measure spectra of Theragenics model 200 and Best Medical model 2301 sources. The thin beryllium entrance window (0.05 cm) allows high transmittance of low energy photons making it ideal for LDR applications. An iterative deconvolution algorithm was used to correct each measured spectrum for detector effects such as efficiency and germanium fluorescence. The deconvolved spectrum represents the photon spectrum incident on the entrance window of the detector. The spectrum was corrected to vacuum to represent the spectrum emitted from the encapsulated source. The spectroscopic air-kerma strength, $S_{K,Spect}$, was calculated from the fully corrected emitted spectrum of each source. A spectroscopic dose-rate constant, Λ_{Spect}, was also calculated for both the models 200 and 2301 using the method developed by Chen and Nath (Med. Phys. 28, 86-96, 2001).

Results: $S_{K,Spect}$ for model 200 and model 2301 sources were calculated. The values were compared with standard S_K measurements showing an agreement of 3.2-3.4% for most sources, while one source exhibited a 12% difference that is being investigated further. Λ_{Spect} was calculated to be 0.699 cGy $h^{-1}U^{-1}$ for the model 200 and 1.033 cGy $h^{-1}U^{-1}$ for the model 2301. These values are within the experimental uncertainty of the consensus dose-rate constant values, which are 0.686 cGy $h^{-1}U^{-1}$ and 1.025 cGy $h^{-1}U^{-1}$, respectively.

Conclusions: The spectroscopic method for calculating the air-kerma strength and dose-rate constant of LDR sources has proven to be a promising technique that can be extended to additional source models and new designs entering the market.