AbstractID: 9600 Title: DXS a diagnostic x-ray spectra generator

Purpose: To numerically generate radiographic x-ray spectra that can be conveniently employed in radiation transport simulations or other radiation detection applications.

Method and Materials: Based initially on the Tucker, et al model, we developed and evaluated a new code, DXS (Diagnostic X-Ray Spectra), to numerically generate spectra for tungsten-target x-ray tubes spanning the radiographic energy range. The model parameters in our code were adjusted by comparison with corresponding MCNP5 simulated spectra; we modified the semi-analytical formulation for the characteristic x-ray production, a caveat of Tucker's model, by incorporating a factor that better accounts for the dependence of the K-peaks on the tube potential. Parametric fitting functions are used to model the self-attenuation in the target and attenuation due to inherent and added filtration (aluminum, beryllium, copper, tantalum are the options implemented in the code), as well as for the tungsten mass stopping power and the Thomson-Whiddington constant. Comparison with Monte Carlo simulated and published measured spectra were used to validate the new code.

Results: Normalized to unit area DXS code-generated spectra for several tube potentials from 50 to 140 kVp agree well, less than 2% relative difference in nearly all energy bins (2 keV), with corresponding MCNP5 simulated spectra for similar tube parameters. Few exceptions are noted and may be attributed to either poorer statistics in the low and high energy tails of the spectrum, or to insufficient accuracy of the numerical computations for the steepest part of the spectra at high accelerating potentials. Good agreement is seen between the DXS and Bhat et al measured spectra.

Conclusion: The DXS code generates the spectra, according to user specified input parameters (tube potential, anode angle, filtratation) and energy intervals, and augments them into any discretized energy group structure. Hence, the code can be of great benefit in radiation transport simulations.