AbstractID: 6755 Title: A test for water equivalence of solid phantoms in the kilovoltage photon energy range

Purpose: To test water equivalence of solid phantoms in the kilovoltage photon energy range

Method and Materials: Three solid water-type phantoms and perspex were compared with water. Technetium-99m radionuclide was confined within and collimated by a lead container to produce a narrow beam of photons of 5 mm diameter. The transmitted gamma rays were measured as a function of phantom thickness using a Phillips Skylight gamma camera. An energy window of ±10% was set to exclude low energy scatter. This setup was modeled within the EGSnrc Monte Carlo code V4.2.2 and the FLURZnrc user code. The total fluence was scored after passing through the different phantom thickness. The linear attenuation coefficient was calculated from the resultant transmission curves and compared with published NIST data using the XCOM program.

Results: The measured transmission values for the Plastic Water, RMI-457 Solid Water and RW3 phantoms were in good agreement with those for water, with a maximum difference of 1.5%. However the transmission values through perspex differed by up to 4% as compared to water. The agreement between EGSnrc and measured transmission values was good, with a maximum difference of 1.3% for all phantom materials. The linear attenuation coefficients derived from measurements and EGSnrc calculations agreed to within 2.4%. For all phantom materials, the NIST linear attenuation coefficient was greater than the measured and EGSnrc calculated coefficients. Differences between experimental values and published NIST data are attributed to the energy resolution of the scintillator crystal within the gamma camera and limitations in the source description for the Monte Carlo calculations.

Conclusion: This work has demonstrated a simple method for testing water equivalency of solid phantoms at low photon energies using gamma ray transmission values determined from measurements and Monte Carlo calculations.