AbstractID: 9676 Title: Neutron energy and dose considerations of Cf-252 brachytherapy sources for various geometries

Purpose: To examine the effect of the ^{252}Cf source size to the neutron energy spectrum and dose contribution in a tissue equivalent material, with and without boron neutron capture enhancement.
Method and Materials: Version 2.5.0 of the MCNPX computer code (Pelowitz, 2005) was used in this study to calculate the neutron energy spectra and dose distribution with and without 10B loading for 252Cf sources of various geometries. A spherical phantom geometry with a centrally positioned ^{252}Cf point-source was first implemented in order to verify our simulation code by reproducing existing data in the literature. The neutron energy flux was calculated for various ^{10}B loadings and various distances from the source. Cylindrical sources of different sizes were simulated in a 30×30×30 cm^3 water phantom and the neutron energy flux and energy deposition in the medium was calculated on cylindrical surfaces enclosing each source at various distances from each source surface. The boron enhancement of 30 ppm was also studied in this case. The neutron energy spectrum was modeled as an isotropic Watt distribution and all calculated spectra were normalized assuming the same amount of ^{252}Cf distributed uniformly inside the source volume.
Results: Calculated neutron energy spectra for the ^{252}Cf point-source geometry showed very good agreement with existing literature, verifying our simulation model. For the cylindrical ^{252}Cf sources, preliminary results showed increased fast neutron contribution from the compact source, as compared to the conventional one, especially at small distances from the source surface.
Conclusion: Smaller size ^{252}Cf sources can be more beneficial for brachytherapy treatments, not only due to localized dose distribution, but also due to higher dose contribution from fast neutrons of high RBE at small distances from the source.