AbstractID: 5192 Title: Calculation of the dose distribution around a high dose-rate 192Ir brachytherapy source via a Multi-group discrete ordinates method

Purpose: To calculate the dose distribution around a high dose-rate (HDR) ^{192}Ir brachytherapy source in water by a multi-group discrete ordinates code and compare with a benchmarked Monte Carlo calculated dose distribution.

Methods and Materials: The multi-group discrete ordinates code, Attila™ version 5.0.2 (Transpire Inc., Gig Harbor, WA) was used to calculate the dose distribution around the Nucletron microSelectron HDR source (Nucletron B.V., Veenendaal, The Netherlands). MCNPX 2.4.k was used to benchmark the deterministic calculations. The source was constructed with Solidworks (Solidworks Corp., Concord, MA), a mechanical design software. The constructed geometry of the source, dose scoring plane and sphere were exported in Parasolid® file format so that it could be imported into Attila.

MCNPX 2.4.k was used to compute the Monte Carlo dose distribution. 50 million histories were simulated resulting in standard errors of the mean of less than 5% at a point 7 cm from the center of the source. The source geometry was identical to that of the Attila run except for minor differences in modeling the source due to limitations of the MCNPX code.

Dose rate matrices were exported from both codes and imported into an in-house data analysis software. This software overlaid the matrices and quantified the percent dose difference and distance-to-agreement for all points in the matrices. The number of points passing a 2%/2mm criterion were reported.

Results: Attila calculated dose to within 2% or 2mm for 99% of the points. The Attila calculations required approximately 38 minutes of CPU versus 568 minutes for MCNPX on the same CPU.

Conclusions: The Attila multi-group discrete ordinates code accurately calculated the anisotropy from the microselectron HDR source. Attila accurately calculated dose in an efficient manner.