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abstract

Source Design and Calculation of Air-kerma Strength of the New Bebig Isoseed® 103Pd Interstitial Brachytherapy Seed using EGSnrc Monte Carlo Modeling

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Source Design and Calculation of Air-kerma Strength of the New Bebig Isoseed® 103Pd Interstitial Brachytherapy Seed using EGSnrc Monte Carlo Modeling

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Introduction: Monte Carlo (MC) is a tool for combining distributions and thereby propagating more than just summary statistics. It uses random number generation, rather than analytic calculations, and is increasingly popular due to high-speed personal computers. Brachytherapy is a special method of therapeutic radiation that creates enthusiasm with the radioactive source that is within a distance between the target and the tumor. The exact dosimetry of the source is very important for this treatment. There are two ways for this dosimetry: the experimental process and the MC simulation process. The experimental measurement is very complicated and compromised with few a percent of uncertainty. Therefore, the MC simulation process has become an acceptable method throughout the world for its simplicity and accuracy. The goal of this research was to design Isoseed® 103Pd for the interstitial brachytherapy source and to calculate the air-kerma strength (Sk). The total calculation was performed by the Monte Carlo simulation code system EGSnrc following the TG-43 formalism. The code FLURZnrc was used to calculate the air-kerma strength.

Methodology: The source was designed accurately following the radioactive seed information, where the source is uniformly distributed throughout a cylindrical alumina core with an inner and outer diameters within the core is a long gold rod, and the core is encapsulated in a hollow titanium tube. The source was designed to make the INPUT file. The PEGS4 file and the SPECTRUM file were used to run this INPUT file. Appropriate photon cut-off energy (PCUT) =0.001 MeV, for electron cut-off energy (ECUT) = 1 MeV, and a number of histories of 107 were considered.

Results: The air-kerma strength per unit source activity for dry air was taken from the simulated result. It was found 8.651E+09±3.5% U.*Bq*−1 at 1 meter distance from the radial axis of the designed source of Isoseed® 103Pd.

Conclusion: The OUTPUT file represented fluence data for different regions at different radiological distances. But the air-kerma strength was calculated by using the fluence data of that region, which was situated at 100 cm distance from

the source center. The average fluence at 100 cm distance was 2.239E 02±3.0%. The air-kerma strength calculation was done following the air-kerma strength calculation from "Spectra and air-kerma strength for encapsulated 192*Ir* sources" by Jette Borg and David W.O.Rogers.

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