D-D and D-T Brachytherapy Neutron Sources*

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Abstract:

A compact D-D/D-T fast neutron Brachytherapy device is being developed at Lawrence Berkeley National Laboratory. Fast neutrons have demonstrated successful treatments for bulky tumors such as prostate cancer, gynecologic cancer (vaginal cavity, cervix or uterus), breast cancer, biliary tract, pancreas, head and neck cancer, endobronchial cancer, esophageal cancer, and soft tissue sarcomas. However, conventional Brachytherapy neutron sources, which use radioactive nuclides such as ^{252}Cf, will require a sophisticate remotely loading device and shielding in order to reduce the clinical personnel's occupational dose. Hence, there is no high-dose-rate ^{252}Cf source currently available in the United States. It is shown that a needle-size D-D/D-T neutron generator can deliver the same fast neutron dose to the patient in a shorter treatment time reducing the risk of deep vein thrombosis or thrombophlebitis. Because the device can be switched off, the clinical personnel's occupational dose will be zero without any shielding when it is not in operation. This advantage also eliminates the cost of a remotely source loading device for a radioisotope source with high neutron yield. Our computational results show that the spatial distribution of neutron dose can be tailored by inserting a single D-T needle at different locations in a tumor or multiple D-D needles from a neutron generators station at the same time. For D-D neutron generators, treatments can be enhanced with boron carrying pharmaceutical drugs when a large tumor is being treated.

Keywords: Brachytherapy, fast neutron, accelerator

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