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Development and Performance Testing of a 1.2 MV DC Power Supply for an Electrostatic Tandem Proton Accelerator in Accelerator-Based Boron Neutron Capture Therapy

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Accelerators have now become the main source of epi-thermal neutrons for clinical BNCT applications. The electrostatic tandem proton accelerator system, designed to produce H^- ions, removes two electrons using an argon gas stripping system located on the high-voltage deck. The resulting protons are then accelerated, representing a significant advancement in generating high flux neutrons through collisions with targets like lithium for medical applications. To maintain the proton accelerator, key accomplishments in this process include the generation and continuous operation of a high-voltage DC power supply at 1.2 MV and 45 mA for more than 30 minutes. We present the development and performance testing of a 1.2 MV high-voltage direct current (DC) power supply housed within an SF_6 gas insulating chamber. This power supply is intended for use in an electrostatic tandem proton accelerator, which serves as a key component of an accelerator-based boron neutron capture therapy (BNCT) system. The DC power supply system incorporates an enhanced Cockcroft-Walton (CW) rectifier stage and includes a realistic load resistance. Final testing was successfully conducted in an SF_6-filled tank, which involved comparing analog voltage and current signals with their digitally converted values, among other evaluations. Our goal was to achieve voltage stability at 1.2 MV within 0.025%, but the system demonstrated even greater stability than targeted. Performance tests conducted in both atmospheric and SF_6 gas environments confirmed stable operation of the power supply at up to 0.5 MV/20 mA in the atmosphere and 1.2 MV/45 mA in SF_6 gas, despite challenges such as corona discharge and electrical arcing in the atmospheric setting. The developed high-voltage DC power supply system can enhance BNCT systems by providing stable operation and generating high-current proton beams, which can lead to improved treatment outcomes.

Paper submission Plan

Yes

Best Presentation

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Primary author: PARK, Chawon (Korea Institute of Radiological & Medical Sciences (KIRAMS))

Presenter: PARK, Chawon (Korea Institute of Radiological & Medical Sciences (KIRAMS))

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