

## **ABSTRACT**

*Proton therapy has dosimetry advantages due to its focused dose deposition, but high-energy protons can produce secondary neutrons that increase radiation exposure outside the therapy room. This study aims to analyze the distribution of neutron ambient equivalent  $H^*(10)$  dose at the Compact Proton Therapy Center (CPTC) facility and verify the effectiveness of radiation protection from the neutron radiation shielding system using Monte Carlo-based MCNP6.2 software. This simulation uses 230 MeV proton energy and four variations in the direction of the proton beam ( $0^\circ$ ,  $90^\circ$ ,  $180^\circ$ , and  $270^\circ$ ) to assess the effect of gantry orientation on the  $H^*(10)$  neutron dose on all walls and ceilings of the facility. The results of the study show that the distribution of neutron doses is greatly influenced by the irradiation direction, with the largest hotspots appearing on the walls, particularly wall C (up to 3.5 mSv/year) and wall D (up to 1.1 mSv/year), both of which exceeded the annual dose rate limit recommended by the Nuclear Energy Regulatory Agency (BAPETEN), which is 1 mSv per year. This condition indicates that each gantry orientation or irradiation beam direction has different shielding weak points. Overall, this study confirms that design verification of shielding using Monte Carlo simulation is an important step prior to the construction of a proton therapy facility to ensure radiation safety and compliance with national regulations.*

*Keywords: Proton therapy, Ambient equivalent dose, Radiation protection, Radiation shielding, MCNP6.2*