AbstractID: 9559 Title: Measurement of Neutron Spectrum and Ambient Dose Equivalent around a Mini-Phantom at a Proton Therapy Facility

Purpose: To determine neutron spectra and ambient dose equivalents (H*(10)) for out-of-field and in-field-out-of-range locations around a mini-phantom irradiated by proton beams.

Method and Materials: A dual-activation foil-based Bonner sphere (BS) and BS extension (BSE) system was used to determine the neutron spectral fluence in conditions typical for treatment of pediatric patients with proton beams. Proton beams with nominal energies of 120 MeV and 180 MeV were modulated to generate in water 5.0-cm Spread-Out-Bragg-Peak (SOBP)/5.5-cm range and 15.0-cm SOBP/15.5 cm range, respectively. Brass apertures were placed in the large snout at the end of the treatment nozzle to project a 5x5 cm^2 field at isocenter. Lucite blocks with a cross-section of 6x6 cm^2 and thicknesses of 5.7 cm and 14.7 cm were used for the 120- and 180-MeV beam irradiations, respectively. Neutron H*(10) was calculated using the fluence-to-ambient dose equivalent coefficients from ICRU report 57.

Results: The H*(10) was determined at three locations around the mini-phantom: 25 cm from the isocenter perpendicular to the beam axis (L1), 25 cm from the isocenter along the axis downstream (L3), and 35.4 cm from the isocenter along 45° downstream (L2). The H*(10) for the 180-MeV irradiation were 6.89, 4.07, and 4.60 mSv/Gy at L1, L2, and L3, respectively, and was 6.18 mSv/Gy at L1 when the mini-phantom was removed. For the 120-MeV irradiation, the H*(10) were 1.21, 0.774, and 0.919 mSv/Gy at L1, L2, and L3, respectively, and was 1.06 mSv/Gy at L1when the mini-phantom was removed.

Conclusion: The neutron spectrum near the isocenter has a two-peak structure, with peaks near 1 MeV for both energies and a peak near 110 MeV for the 180-MeV and near 80 MeV for the 120-MeV proton irradiations. Neutrons below 100 keV contribute less than 2% of the ambient dose equivalent.

Conflict of Interest: None