AbstractID: 9531 Title: Monte Carlo-based pre-installation proton therapy faciltiy shielding verification for a single-room proton therapy facility

Purpose:
To validate analytic shielding and maze calculations prior to construction of a doorless in-room accelerator proton therapy facility.

Method and Materials:
The MCNPX Monte Carlo program (version 2.6c) was used to model the treatment facility. LA 150 cross-sections were used for all materials available. Maze walls, floors, and shielding walls, including all passage ways were included in the room geometry. Treatment losses were modeled with an Fe target placed at isocenter. The cyclotron was geometrically modeled with anticipated proton loss points. The cyclotron was modeled both with and without localized compound shielding. Simulations were performed for gantry angles of 0^o, 90^o, and 180^o for the target source and 0^o, 90^o, and 135^o for the cyclotron source. The 135^o beam was simulated since it places the accelerator in a direct line-of-sight of an personnel access area in the lower level shielding wall. Neutron dose equivalent and photon dose values were tallied using mesh tallies throughout the treatment room, maze, and outside of the shielding enclosure and compared with design values. Neutron dose equivalent estimates used the ICRP-74 neutron flux-to-dose rate conversion factors.

Results:
MCNPX simulations confirmed the analytical shielding estimates and indicated areas of under and over-shielding in the facility plans. Beyond the shielding walls, photon dose equivalent values were less than 10% of the neutron values. Neutrons streaming from the accelerator through a lower maze shielding void contribute to the personnel dose to in the treatment control area. Use of 1” of simple compound shielding reduces this contribution by a factor of 2.25.

Conclusion:
MCNPX is a valuable tool for pre-installation verification of shielding design and indicate that doorless proton therapy vaults are feasible.