AbstractID: 9056 Title: Design and Shielding Considerations for the World's First Compact Synchrocyclotron Proton Therapy Unit

Purpose: Our institution will soon take delivery of the Monarch 250 Compact Proton Therapy Unit (Still River Systems). We performed facility shielding calculations that accounted for the produced neutron flux.
Method and Materials: Workload assumptions (80Gy/day) yielded the number of protons produced per day. The vendor did not provide extraction efficiency, neutron yields from the treatment field shaping system, or neutron yield estimates from the synchrocyclotron. To provide a conservative neutron yield we assumed; the largest scattered field size and complete portal blocking, conservatively low cyclotron production efficiency (25%), and a high quality factor (20) for neutron dose equivalent calculations. Neutrons were assumed to be produced at the isocenter location, by stopping the SOBP protons in a Cu target. The room design includes a sub-floor to allow rotation of the accelerator below the sub-floor level. Classical analytical methods were used to calculate required barrier thicknesses based on neutron yields, accounting for angular dependences, and based on concrete (standard or high density (HD)), earth, and steel. Maze calculations used analytical approaches, heavily influenced by the number of bounce paths, and maze area. Conservative use and occupancy factors were used.
Results: The shielding calculations resulted in barrier thicknesses similar to existing proton facilities; from 4ft to 6.25ft of HD concrete. Some design features included; reducing the maze ceiling height to reduce the source area of scattered neutrons, adding an additional leg at the door entrance to allow for an unshielded door, and adding steel to surround unavoidable barrier voids. To reduce cost, the barriers that did not shield occupy-able space, used standard concrete.
Conclusion: The neutron yield from the Monarch 250 is unknown, so conservative values were used in the shielding calculations. Vault design strategies were developed to reduce overall construction cost. We allow for contingencies if we underestimated any barrier thickness.