

AbstractID: 11864 Title: Measurement Validation of Attenuation Values of Proton Facility Shielding Materials

Purpose: Strategies for design and shielding methods vary considerably with proton facilities. Material chosen for shielding is balance of effectiveness and cost. For space-restricted environments, high-density materials are desirable. Shielding calculations, whether analytical or statistical rely, on the neutron attenuations properties of chosen materials. The purpose of this study was to measure and calculate attenuation of various materials to be used for shielding.

Methods and Materials: We acquired samples of the actual materials to be used to shield neutrons for our new facility. The original calculations relied on analytical methods and classically accepted values for neutron attenuation. Planned materials include: standard concrete (SC)~136lb/ft³, high-density concrete (HDC)~250lb/ft³, Hematite mix (HM), steel (S), and borated polyethylene (BP). For the measurements, we used a 5Ci plutonium-beryllium (²³⁹PuBe) neutron source (1" in diameter and 5" in length) with an energy spectrum ranging up to 11MeV. A Bonner-sphere spectrometer was used for neutron measurements. The material samples were configured in a manner to allow measurements through various paths. A Fortran code was used to reconstruct the neutron spectrum and calculate the neutron dose equivalent.

Results: Transmission curves were generated to yield TVL values, which were compared to those used in our analytical calculations. Measured TVL (cm) for the SC, HDC, HM, S, and BP were 55.9, 55.1, 63.1, 35.6, 60.6, respectively. The TVL (cm) used for the calculations were 85.6, 52.4, 32.9 respectively for SC, HDC, and S.

Conclusions: Measured TVL values matched analytical calculations very closely, with the exception of standard concrete. The measurements performed in this study assisted in better understanding of attenuation properties of each material and increased our comfort level pre-construction. As expenditures in the range of millions of dollars were about to be spent, the question of material choices, and the validity of the actual material mix were alleviated.