AbstractID: 6664 Title: Brachytherapy source power measurements using a liquid helium active radiometric calorimeter

Purpose: To characterize a liquid helium active radiometric calorimeter for contained power and emitted power measurements. The calorimeter has been used for direct measurement of low dose rate and beta emitting brachytherapy sources.

Method and Materials: Measurements were performed by placing a brachytherapy source into a silver absorber whose temperature was actively controlled slightly above that of liquid helium. An electrical substitution method was used; so the difference in power required to maintain a set temperature with and without the source present was attributed to the source itself. Corrections for increased thermal mass of the system during measurement were determined empirically using nonradioactive "dummy" sources, and corrections for escaped energy were calculated using Monte Carlo MCNP5 models. Data were analyzed using a linear least squares approximation of values obtained while the source was in place and after the source was removed. The distance between the fit lines at the time the source was removed was taken as the source power. Individual ^{125}I, ^{103}Pd, and $^{90}Sr/^{90}Y$ sources were investigated.

Results: Classical variance for preliminary measurements was found to be 60nW. The correction factor for source thermal mass was 0.611µW; and for ^{125}I, ^{103}Pd, and $^{90}Sr/^{90}Y$, respectively, corrections for escaped energy were 1.0000, 1.0045, and 1.0182 for contained power measurements and 1.0081, 1.0101, and 1.0823 for emitted power measurements.

Conclusion: Preliminary results reveal improved sensitivity of the instrument over the previous liquid nitrogen version (Rev. Sci. Instrum., 76, 2005). Small thermal drifts during measurement indicate that slight further modifications to the design may be required to anchor the absorbers fully to the actively controlled detector housing. Also, increasing the size and weight of the source insertion cap may also improve measurement repeatability. While preliminary data are promising, further measurements will improve dataset statistics for both radioactive sources and the measured correction factor.