AbstractID: 11793 Title: Procedure for Dose Rate Determination via System Response of A Water Calorimeter

Purpose: To extract a consistent dose rate from water calorimetry measurements for all irradiation times.

Method and Materials: Conventionally, the dose rate is determined at a length of time short compared to the heat conduction time in the system with the correction made by a model calculation for the given length of time (denoted t_open). We advocate a systematic approach by tracing the response of the calorimeter beyond the small t_open (10s of seconds) to 100s of seconds where conduction effect contributes significantly, requiring conduction correction to be valid over the entire time scale. This is made practical by modulating the radiation shutter at various t_open and by frequency domain analysis. The output from a 3D finite element model simulating the experimental protocol in a Co-60 beam with a 20 mm radius vessel undergoes the same analysis as the experimental data to extract the response to unity radiation dose which can be scaled to any dose rate.

Results: We scale the calculated curve to match the data by chi-square minimization; the scaling factor represents the dose rate for all t_open values. Two sets of data were analyzed; the results for t_open from 60 s to 240 s are compared to Domen's transfer value (t_open=70 s) at standard geometries (SSD=100 cm), yielding a dose rate 1.0% and 0.9% below the transfer values (1 sigma statistical uncertainty 0.44% and 0.17%), respectively. A set of data taken at SSD of 77.4 cm gives a dose rate 3.4% below the transferred value. Ion chamber measurements will be made to resolve this discrepancy.

Conclusion: A procedure to derive the dose rate by requiring self-consistency between the modeled and the measured system response of the calorimeter over large time scales is a step closer to re-establish a primary standard using a water calorimeter.