Abstract ID: 16660 Title: Calibration of a Reference Standard Ionization Chamber in 6- and 18-MV Photon Beams using a Sealed Water Calorimeter at Room Temperature

Purpose: To investigate the feasibility of using room-temperature water calorimetry for the calibration of ionization chambers in high-energy x-ray radiotherapy beams.

Methods: 6- and 18-MV photon beams provided by a Clinac 2100C were used to compare dose measurements from a sealed, Domen-type water calorimeter operated at room temperature and an Exradin A12 ionization chamber, calibrated in Co-60. Measurements were conducted at 10-cm depth in a 27-liter, cubic water phantom, with SSD = 100 cm. For both energies, the Clinac was configured to deliver a 10-cm x 10-cm beam at the water surface with a nominal dose rate at dmax of 2.4 Gy/min, arranged as a sequence of 1-minute exposures separated by 1-minute rest intervals that would typically proceed for one hour per run. Beam stability was monitored by a PTW pancake chamber of 10-cm diameter. Calorimeter response, analyzed via mid-point extrapolation and Fourier analysis, was scrutinized for evidence of natural convection. A further test for convection within the calorimeter was done by gauging its linearity as the nominal dose rate of an 18-MV beam at 10-cm depth was varied from 0.64 to 3.2 Gy/min.

Results: Average dose measurements obtained from nearly a dozen calorimeter runs at each of 6- and 18-MV were determined with a precision of better than ±0.15% (1 std) and agree with chamber measurements, obtained via kQ factors obtained from TG-51, within experimental uncertainty. No evidence of convection was observed in the calorimeter data, and its response over the 5x variation in dose rate was found to be linear with standard error on the slope of <0.15%. Standard correction factors will be assessed.

Conclusions: Direct calibration of ionization chambers via room-temperature water calorimetry appears feasible. Further studies of calorimeter response at 4-deg C, where convection is extinguished, are anticipated.