AbstractID: 6875 Title: Comparison of detectors for electron depth-dose measurements and investigation of parallel-plate chamber perturbation factors

Purpose:
In all international protocols for electron beam dosimetry the primary detector of choice for measuring depth-dose distributions is the plane-parallel ionization chamber. Diode detectors are permitted but their performance must be checked against a 'gold-standard' ion chamber before use. Recent publications have indicated that parallel-plate ion chambers can have a significant non-zero perturbation correction, which varies with depth. If this is not corrected for then the chamber is not a 'gold standard' and any comparison with a diode will be biased. This also has implications for benchmarking of Monte-Carlo simulations.

Method and Materials:
A precision 1-D scanning phantom was developed with an absolute positioning accuracy of 0.15 mm and a dose uncertainty of 0.1%. Measurements were made with two types of plane-parallel ion chamber (NACP and Roos) and two electron diodes (Scanditronix EFD and PTW 60012) at a range of electron energies (4-22 MeV) for 4 different linac types.

Results:

i) There was very good agreement between the plane-parallel ion chambers (R_{50} values generally within 0.1 mm for all beams)

ii) There was a significant and consistent difference between the electron diode detectors, with a 0.7 mm difference in R_{50} (independent of energy) and small differences in the build-up and bremsstrahlung regions.

iii) The ion chamber plots (converted from ionization to dose using TG-51 and corrected for chamber perturbation using published data) showed very good agreement with the EFD diode, except for in the build-up region where a difference of ~1-2% persists.

iv) The corrected ion chamber and EFD diode showed good agreement with a Monte-Carlo simulation but neither matched perfectly.

Conclusion:
For the highest accuracy depth-dose measurements (e.g. TG-51 beam calibration, MC commissioning) perturbation corrections are required for plane-parallel ion chambers. Further work is required to determine which detector (diode or ion chamber) is a true 'gold standard'.