AbstractID: 3499 Title: Comprehensive empirical formulation for treatment planning of small clinical electron fields

Purpose: To develop a comprehensive empirical formulation to predict the dosimetric properties of small electron fields at nominal and extended SSDs.

Method and Materials: A set of circular electron cutouts with physical diameters from 2 to 9 cm was constructed in the usual clinical manner. A full dosimetric analysis of the fields defined by each cutout was done for nominal electron energies between 6 and 20 MeV using a 3D water phantom and a pin-point ion chamber. Properties studied included depth dose, in-air inverse-square fall-off, and beam profiles. After appropriate benchmarking, these properties were further studied with Monte Carlo simulations using the BeamNRCMP code. From the physical data and simulations the following parameters were determined for each cutout/energy combination: R50, R90, widths of 90% and 95% isodose surfaces, effective SSD, and dose output factor. The parameters were then correlated with collimator size, giving a suite of equations accurately defining the dosimetric properties of these fields.

Results: Rules of thumb regarding properties of electron fields are typically used in deciding the shape and nominal energy of electron fields. The cadre of formulas developed in this work more accurately predicts the dosimetric behavior of small electron fields where significant deviation from expected dosimetry can occur. We found a large difference in the 95% and 90% isodose widths as a function of field size and nominal beam energy. Moreover, the effective SSD was found to be a strong function of field size.

Conclusion: The formulation developed in this work accurately describes the clinical dosimetric properties of small electron fields. It can be used to select the size and shape of an electron cutout needed to provide the desired coverage at a given depth. Furthermore, the output of these small fields can also be calculated, obviating the need for a measurement.