AbstractID: 10226 Title: Monte Carlo Simulation of Batch Assay of Iodine-125 Seeds Preloaded in Unshielded Cartridges

Purpose: Although the feasibility of batch assay of LDR brachytherapy sources has been proposed, the technique has not gained widespread clinical acceptance due to the uncertainties in the measurement of packaged seeds. Interest in batch assays has been revived with the availability of preloaded seeds in a cartridge, which permits all seeds to be assayed in bulk and limits radiation exposure. In this study, the batch assay of I-125 seeds was simulated by Monte Carlo method including the evaluation of the correction factor between individual and batch assays.

Method and Materials: To validate the initial simulation model, both FLUKA and DOSRZnrc/EGSnrc Monte Carlo code were used to calculate the dose distribution of single I-125 seed based upon the TG-43 formulation. Further simulations of seed assay were then performed by FLUKA code including detailed geometries of the seeds, the unshielded cartridge, source holders and a HDR-1000 Plus well chamber. The sensitivity of the batch scheme was also tested by simulating defective (out of calibration tolerance) seeds in cartridges.

Results: The calculated correction factor is 1.482 (σ=1.60%), which is comparable with the measured result of 1.496 (σ=0.71%). The test of defective seeds shows an average 0.87% error (only 6.64% batches with error >2%) could be found if some seeds in batch with 5%-10% departure from reference activity. An extra and missing seed in cartridge caused 10.45% error in chamber response.

Conclusion: A cartridge assay provides an accurate measurement of the mean activity but could mask large individual seed variability. The correction factor for seeds preloaded in unshielded cartridge could be measured and used confidently. To agree with NRC regulation and AAPM recommendations, all the seeds should and could be measured by batch. The individual sample of 10% of the seeds could then be chose from the cartridges with the most divergent reading.