

AbstractID: 13598 Title: Evaluating AAPM TG-43 in-water HDR  $^{192}\text{Ir}$  brachytherapy reference dosimetry: A comparison study.

**Purpose:** To investigate the accuracy of AAPM TG-43 in HDR  $^{192}\text{Ir}$  brachytherapy in water reference dosimetry by comparing the protocol against ionometric and Gafchromic film calibration procedures introduced as well as a water calorimetry-based primary standard.

**Methods and Materials:** Dose to water  $D_{\text{water}}$  was measured directly in water using an Exradin A1SL farmer-type chamber and EBT-1 Gafchromic films. The chamber had a NIST-traceable  $^{60}\text{Co}$  calibration factor while the films were calibrated under 6 MV photons. Accurate Monte Carlo modeling and simulation of the chamber (egs++) and EBT Gafchromic films (DOSRZnrc) were performed to convert calibration factors of the two detectors from their respective conditions into  $^{192}\text{Ir}$  brachytherapy. The  $D_{\text{water}}$  results were compared to measurements made using a Standard Imaging well-type chamber following AAPM TG-43 protocol and water calorimetry primary standard measurements.

**Results:** By calculating the ratio of dose-to-water to dose-to-gas for the A1SL chamber under reference  $^{60}\text{Co}$  conditions and  $^{192}\text{Ir}$  setup conditions, the ionization measurements in  $^{192}\text{Ir}$  were converted to dose to water. The Monte Carlo calculations in film dosimetry revealed that if the intrinsic energy dependence of the film is negligible, a sensitometric curve obtained with 6 MV can be used in  $^{192}\text{Ir}$  measurements, with the energy dependence correction being 0.9971 ( $1 \pm 0.1\%$ ). The overall one-sigma uncertainty on ionization chamber, Gafchromic film, and water calorimetry dose rate measurement amounts to 1.44%, 1.78%, and 1.96%, respectively. The indirect  $D_{\text{water}}$  measurements from TG-43 agreed to within 1.4% with ionometric measurements, 0.3% with Gafchromic measurements, and 0.6% with Calorimetric absolute dose measurements.

**Conclusions:** Accurate ionometric and Gafchromic film based calibration protocols are introduced. For  $^{192}\text{Ir}$  brachytherapy, the 1-sigma uncertainty of TG-43 reference dosimetry was found to be better than 1.4%.