

AbstractID: 3097 Title: Dose rate constant of the Cesium-131 (model CS-1) interstitial brachytherapy seeds measured by thermal-luminescent dosimeter (TLD) and by Gamma-ray spectroscopy

**Purpose:** To measure the dose rate constant of the model CS-1 low-energy interstitial brachytherapy seeds containing  $^{131}\text{Cs}$ .

**Method and Materials:** Eight  $^{131}\text{Cs}$  seeds were obtained from the seed manufacture (IsoRay). The air-kerma strength of each seed was measured by the manufacture whose dosimeter calibration is traceable to the air-kerma strength standard established for the  $^{131}\text{Cs}$  seeds at NIST ( $1\sigma$  uncertainty  $< 1\%$ ). The dose rate constant of each seed was measured by two independent methods: One based on the actual photon energy spectrum emitted by the seed using gamma-ray spectroscopy and the other based on the dose-rate measured by thermal-luminescent dosimeter (TLD) in solid-water phantoms.

**Results:** The dose rate constant in water determined by the gamma-ray spectroscopy technique and by TLD dosimetry are  $1.066 \pm 0.049 \text{ Gyh}^{-1}\text{U}^{-1}$  and  $1.069 \pm 0.096 \text{ cGyh}^{-1}\text{U}^{-1}$ , respectively, showing excellent agreement with each other. These values, however, are approximately 15% higher than a previously reported value of  $0.915 \text{ cGyh}^{-1}\text{U}^{-1}$  (*Med. Phys.* **31**, 1529-1538, 2004). Since the average photon energy emitted by  $^{131}\text{Cs}$  is on the order of that emitted by  $^{125}\text{I}$ , the previously reported value could only be possible if the  $^{131}\text{Cs}$  seeds had generated a significant amount of lower energy fluorescent x-rays. Fluorescent x-rays at 16.6 and 18.7 keV originating from Niobium in the seed construction were indeed measured in the energy spectra but their yields were not sufficient to lower the dose rate constant to  $0.915 \text{ cGyh}^{-1}\text{U}^{-1}$ .

**Conclusion:** The dose rate constant of the model CS-1  $^{131}\text{Cs}$  seeds was carefully determined using two independent methods. A large discrepancy ( $> 15\%$ ) was observed against a previously reported value. Additional determination of the dose rate constant may be needed to establish an AAPM recommended census value.

**Conflict of Interest (only if applicable):** None