Waste Management Protocols for Iridium-192 Sources Production Laboratory Used in Cancer Treatment

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Abstract. Introduction: Brachytherapy is a form of treatment that uses radioactive seeds placed in contact or inside the region to be treated, maximizing the radiation dose inside the targeted areas. Iridium-192 is being used in brachytherapy since 1955. It presents emission energy in the "therapy region" (370keV) and is easily produced in a nuclear reactor (^{191}Ir (n, γ) → ^{192}Ir). Wires are an iridium-platinum alloy with 0.36 mm diameter and they can be cut in any needed length. They can be used in several types of cancer. The linear activity is between 1 mCi/cm (37 MBq/cm) and 4 mCi/cm (148 MBq/cm) with variations of 10% in 50 cm maximum. This activity values classified the treatment and low dose rate (0,4 à 2 Gy/h). The propose of this work is to present a waste management system in a cancer treatment radioactive sources production laboratory. Methodology and Results: The solid waste is previously characterized in the analysis phase. The contaminants are already known and they are insignificant due to their fast half- life. The iridium-192 half-life is 74.2 days, classified as very short half-life waste. The waste activity is adds to 8mCi (2.96x10^{8} Bq) per wire. According to the CNEN-NN 6.08 standard, that presents the discharge levels, the limit is 1 kBq.kg^{-1} (2.7x10^{-5} mCi.kg^{-1}). The radioactive waste generated during the I^{192} wires production has a weakly activity of 9.7 GBq.g^{-1}. According to the standards, this activity is too high to be discarded into the environment. The waste must be managed following the ALARA principal using the R&R (retain e retard) system, that means, temporary storage and posterior discharge. Since every 4 months, maintenance is performed inside the hot cell used for production, the waste must be removed. Using the equation: $A = \frac{L}{\lambda}(1 - e^{-\lambda t})$, the total calculated activity is 1.68 x 10^{16} Bq and 4.8 g mass at the end of each 4 months period. This amount is stored inside a shielding device that has 212.37 cm^3 volume. The waste will take 9.8 years (calculated by $A = A_0(e^{-\lambda t})$) to decay to the discharge levels. To store 30 devices during 10 years, a space with 6,370 cm^3 is necessary. The laboratory has enough space for this storage. Thus, the radioactive waste management can be performed through the R&R (retain and retard) system safely.