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Radiation Protection Aspects Related to Lutetium-177 Use in Hospitals

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177Lu is typically produced by direct irradiation with neutrons from enriched 176Lu. During direct irradiation of 176Lu remarkable amount of 177mLu (T1/2 = 160 d) is produced.

The 177mLu content in the labelling solution is mainly depending from the two factors: irradiation time and how much time has passed after end of the irradiation. Typically carrier added (c.a.) 177Lu is produced in the irradiations positions, where neutron flux is 1 3*1014 neutrons cm-2 s-1 and irradiation time is 14 days. Reported values for 177mLu/177Lu ratio from several reactors varies between 0,01% - 0,02%. The hospitals are using their 177Lu up to one week after end of the irradiation when 177mLu/177Lu ratio has doubled.

177Lu is mainly used to peptide labelling. Typical dose is 7 –9 GBq. If 177mLu/177Lu ratio is 0,02%, it means that a dose includes 1,4 –1,8 MBq 177mLu.

To handle radioactive materials, which are above free limit, it is required to have a radioactive material licence. For 177mLu free limit is 1 MBq, if free limit is exceeded the nuclide needs specific licence or licence as by product. Hospitals which are using over 5 GBq c.a. 177Lu should have radioactive licence also for 177mLu.

During labelling process and treatment the loss of radioactivity is typically 2 to 5% of activity which is equal to 90 kBq 177mLu. The release limit is 10 Bq/g waste. All waste should be collected and shipped to radioactive deposit or let to be decayed.

A patient is going to extract approximately 80% dose (1,45 MBq) through urine relative fast. The highest allowed radioactive concentration in the sewage water canal is 50 kBq/m3. It means that patient dose need to be diluted to 30 m3 after cooling time, which is required to 177Lu decay.

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