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Activation studies for a beta-beam Decay Ring (DR): residual dose rates during maintenance and airborne activity.

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In a future beta-beam facility radioactive ions (6He and 18Ne) are produced, accelerated and then stored in a large Decay Ring (DR), where they eventually produce anti-neutrino and neutrino beams through β± decay. CERN is one of the candidate sites for the beta-beam facility, as existing machines like the Proton Synchrotron (PS) and the Super Proton Synchrotron (SPS) could be used for the acceleration.
The DR is composed of two long straight sections and two arcs. The straight sections host the collimators and two bumps. The beam is injected into the ring at nearly 92 GeV per nucleon. Beam losses occur in different sections of the machine: relevant losses include collimation losses in the collimation section and the bumps, and decay losses in the magnets in the arcs.
This work focuses on two radiation protection aspects related to the operation of the DR, namely the induced radioactivity and the air activation generated by collimation and decay losses. All the calculations are performed with the Monte Carlo transport code FLUKA and are based on a continuous three-month operation. The induced radioactivity in the machine components and the expected residual dose rates inside the tunnel during maintenance are calculated for three different waiting times. Airborne activity is evaluated through the convolution of predicted particle spectra in the tunnel with isotope-production cross-sections. Using activity-to-dose coefficients, previously calculated for the ISOLDE facility at CERN, and a laminar flow model for the air diffusion, the airborne activity is converted into effective dose to the reference population group.
The results show that residual dose rates during maintenance decrease significantly in a week after the shutdown of the machine, reaching values that correspond, according to CERN area classification, to a limited stay area. The effective dose given to the reference population in one year of operation is below the reference value for CERN emissions into the environment.

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