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# Evaluation of decommissioning of proton therapy centers based on the selection of shielding materials at the building stage of the facility

Radiotherapy using accelerated-protons have growing potential in dealing with some tumours, and consequently, in the last decade proton-therapy centres are growing fast across the world. In these facilities, prompt radiation attenuation is essential to achieve legal dose limits, but not enough to develop efficient radiation protection. Activation of mechanical elements (accelerator, beam devices), ambient (air, water, ground), and of course, the shielding, is another relevant issue, linked with the safety radiation protection conditions, as well as, specially, the future dismantling and management of radioactive materials produced along the operation. Induced radioactivity remains in the walls of centers for several years, even decades, after their closure, therefore, a good inventory estimation, depending on the choice of the shielding material, could be advisable in the early stages of projects.

To estimate and reduce decommissioning costs, which involve a sensitive part of total investment, it is essential to study the complete cycle of life of facility, thus, the goal of this work has been to carry out comparative analyze of neutron activation in shielding of proton therapy centres, depending on the concrete in barriers, using Monte Carlo codes (MCNP6 and PHITS). The assessment cover four types of concrete: conventional, high-density with magnetite, high-hydrogen-content, and low activation. Considering the energy of neutrons in these facilities, up to 230 MeV, and the generation of radioisotopes through both, capture reactions and spallation reactions, several nuclear data were used.

The choice is, therefore, a matter of attenuating prompt radiation below regulatory limits, using materials with low activation to reduce the exposure to gamma radiation of the staff, and to generate radioactive waste as low as possible, and optimizing the expenses. Proton therapy centers are complex facilities, with different radiation areas, and one potential solution could be using different concretes at specific areas, depending on radiation fields at each location.

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