Bulk radioactive residuals from cyclotron decommissioning in the Netherlands: an opportunity for recycling through conditional clearance

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The European and worldwide accelerator park is aging and increased decommissioning activity is foreseen in the near future. Cyclotron usage results in activation of cyclotron parts and concrete bunkers. The aims of this project were to substantiate cost estimates for radioactive waste storage and to identify potential savings and recycling opportunities through conditional clearance.

Information on cyclotron characteristics was obtained from operators. Data on specific activity in materials after cyclotron decommissioning was obtained from literature. Only bulk material - including metals originating from the magnet coils and yoke, as well as the reinforcement bars of the concrete and the inner 50 cm of all bunker concrete – was included. Estimates of activated mass were based on dimensions of representative cyclotrons and bunkers. Materials were judged likely to qualify for conditional clearance when the clearance-weighted sum of present specific activities was below 100.

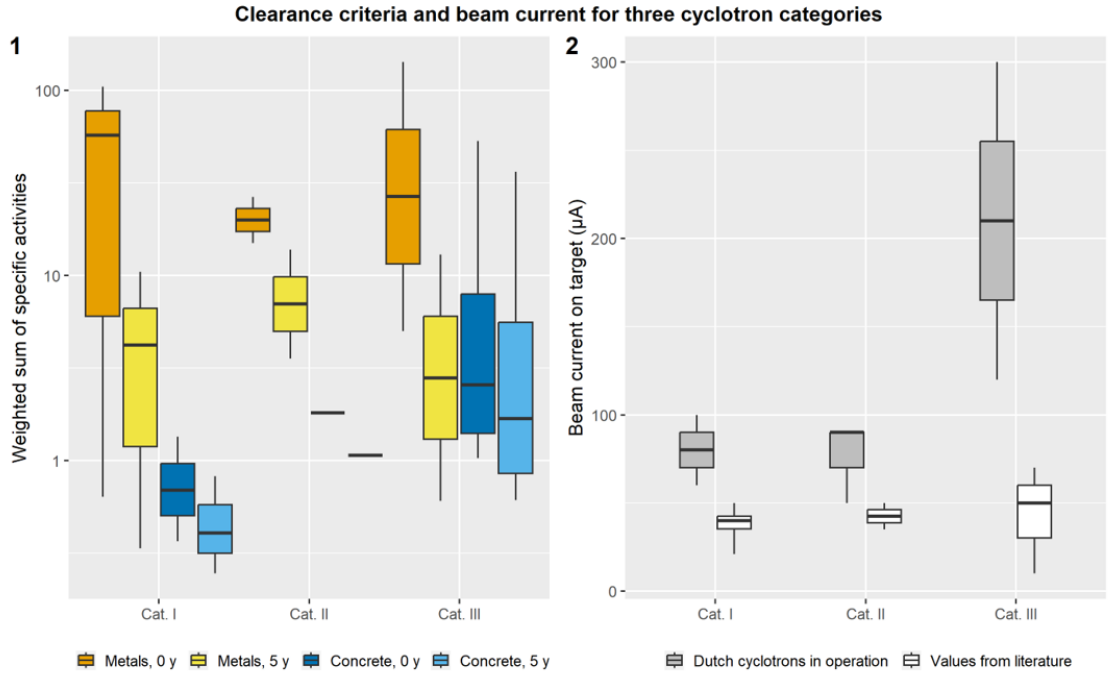

Figure 1. *1: The clearance level found in materials after cyclotron decommissioning in literature. Cyclotrons were divided in three categories based on proton energy (<18, 18, 19-30 MeV for categories I, II and III respectively) and presence of self-shielding (only in Category I). Clearance level was obtained as the clearance-weighted sum of relevant radionuclide specific activities. 2: Typical beam current on target (in μA) for cyclotrons from literature, and for Dutch operating cyclotrons.*

Total yield of radioactive waste for all Dutch cyclotrons was estimated at 4000 – 7000 tonnes of bulk material. Corresponding storage costs at the Dutch Central Organisation for Radioactive Waste (COVRA) would amount to 40 to 70 million euros. More than 90% of bulk material was found likely to qualify for conditional clearance after 5 years post-shutdown. Modern Dutch cyclotrons operate at higher currents than cyclotrons reported on in decommissioning literature; studies must be performed to examine the effect on radioactive waste yield.