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Optimized design of local shielding for the IFMIF/EVEDA beam dump

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IFMIF will be an accelerator-based neutron source to test candidate materials for nuclear fusion reactors. During the Engineering Validation and Design Activities (EVEDA) phase, a prototype accelerator (125 mA CW 9 MeV deuterons) will be tested in Rokkasho (Japan). As no target is foreseen for the accelerated beam during this phase, a beam dump is required to stop it during commissioning and accelerator tests. The piece that stops the beam is a copper cone with a 250 cm length and 30 cm aperture diameter [1]. The impact of the deuterons on its surface gives rise to activation and neutron production at a rate up to 4,6E+14 neutrons per second.

This work describes the design of a local shielding with improved efficiency. Different geometries and materials have been considered, and the design has been optimized taking into account the origin of the doses, the effect of the walls of the accelerator vault and the space restrictions. The initial idea was to shield the beam stopper with a large water tank of easy transport and dismantling but it was shown to be insufficient to satisfy the limit requirements, basically due to photon dose, and hence a denser shield combining hydrogenous and heavy materials was preferred.

It will be shown that, with this new shielding, dose rate outside the accelerator vault during operation comply with the legal limits and unrestricted maintenance operations inside most of the vault are possible after a reasonable cooling time after shutdown.

MCNPX has been used for transport calculations, with specific care for the particle source from deuteron interactions, and ACAB for activation analysis. This work describes the local shielding design process and the most relevant results obtained from the simulations.

References

[1] B. Brañas, et al. Fus. Eng. Des. 84 (2009) 509-513

Primary author: Mr GARCIA, Mauricio (UNED)

Co-authors: Ms MAYORAL, Alicia (UNED); Mrs BRAÑAS, Beatriz (CIEMAT); Ms TÖRE, Candan (SEA); Mr LÓPEZ, Daniel (UNED); Mr OGANDO, Francisco (UNED); Mr SANZ, Javier (UNED); Mr ARROYO, José Manuel (CIEMAT); Mr SAUVAN, Patrick (UNED); Mr ORTEGO, Pedro (SEA)

Presenter: Mr GARCIA, Mauricio (UNED)

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