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Neutronics of the IFMIF-DONES irradiation facility

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Within the Early Neutron Source (ENS) project of EUROfusion the design of the accelerator based irradiation facility IFMIF-DONES (International Fusion Material Irradiation Facility- DEMO Oriented NEutron Source) is under development. The main mission of IFMIF- DONES is to provide the irradiation data needed for the construction of DEMO, a fusion power demonstration reactor developed in the frame of the Power Plant Physics and Technology (PPPT) programme of EUROfusion.

The IFMIF-DONES facility consists of a deuteron accelerator, a liquid lithium target and a Test Cell with irradiation test modules as main systems. Neutronics has to provide the data which are required to design and optimize these systems, evaluate and prove their nuclear performance, and ensure a sufficient radiation protection. In addition, the radioactive inventories, produced during operation, have to be assessed to enable sensible maintenance and waste management strategies.

A variety of neutronics simulations is needed to compute the nuclear responses for all systems and components and provide the radiation fields during operation, maintenance and shut-down periods. Such simulations require dedicated computational approaches adapted to the needs and peculiarities of the accelerator based IFMF-DONES neutron source. The ENS project thus builds on the development of specific tools and data for simulating the interactions of deuterons with the lithium target and the accelerator structures, the generation and transport of neutrons and photons, and the production of radio-active nuclides with the subsequent emission and transport of decay gamma radiation.

The paper presents an overview of the IFMIF-DONES neutronics comprising both nuclear analyses and the applied computational approaches. Main issues are the nuclear analyses conducted lately for the Accelerator Facility and the Test Cell utilizing the specific codes and data developed and/or adapted for IFMIF-DONES. Related R&D issues are also addressed.

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