Status and Recent Developments of IFMIF-DONES: Neutronics Activities

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The properties of materials for nuclear fusion applications are not yet fully understood under the neutron irradiation conditions foreseen in future fusion reactors. IFMIF DONES is designed to address this gap by providing neutron irradiation conditions representative of fusion environments. IFMIF DONES is an accelerator-based neutron source composed of a deuteron injector, a Radio Frequency Quadrupole, a Medium Energy Beam Transport line (MEBT), a Superconducting Radio Frequency accelerator, and a High Energy Beam Transport line (HEBT) to the Test Cell (TC). Together, these systems produce, accelerate, shape, and transport a deuteron beam to a liquid lithium target, generating fusion like neutrons for materials irradiation purposes.

Currently, the IFMIF DONES neutronics team is working in parallel on several key activities. These include: (a) rescoping and consolidating the knowledge transfer and results of the extended neutronics models available for the facility, based on the designs developed up to 2025 in the context of Eurofusion-WPENS collaboration; (b) providing detailed technical information and requirement definitions requested by in kind contributors (e.g., Croatia and Fusion for Energy); (c) supporting the transition of the MEBT, HEBT, and Test Cell—part of the Spanish contribution—into the construction phase; and (d) addressing the final design of the Main Building and site layout, whose construction phase is expected to begin shortly.

To manage these activities and accommodate new design developments, an intensive program of review and nuclear analysis is required, making use of the latest Eurofusion-WPENS results and targeting the licensing process with the Spanish regulatory authority (Consejo de Seguridad Nuclear - CSN). In parallel, the comprehensive characterization of the IFMIF DONES neutron source is a critical objective. To this end, nuclear data validation and diagnostic development are being pursued through the active promotion of complementary experimental rooms, considered as baseline components of the facility to enable such experimental activities in the near future.

This work presents the current status and recent advancements of the IFMIF DONES plant, with a focus on their impact on neutronics activities. In addition, ongoing efforts toward achieving a comprehensive characterization of the neutron field are discussed.

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