Neutronics Analyses of the IFMIF-DONES Test Cell
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Introduction

- IFMIF-DONES is a DEMO Oriented NEutron Source providing the irradiation data needed for the construction of DEMO. The Test Cell (TC) is the central room enclosing the target and the test module.
- The design of the TC is being changed continuously comparing with the IFMIF engineering design (IFMIF/EVEDA). It is necessary to re-evaluate the TC neutronics analysis and provide data for TC engineering design.

Neutronics model

- TC CAD model
- MCDeLicious-17 (MCNP version 6) and FENDL-3.1b neutron cross-section have been used for the calculations.
- Mesh tally with resolution of 5 × 5 × 5 cm³ covers the center region and 1 m-thick wall.

Liner nuclear responses

- TC liner is the confinement of TC atmosphere and the accidental lithium leakage.
- The detail results on the TC liner have been obtained using an unstructured mesh based interpolation method.
- Actively cooling of the liner is required to remove the convective and radiation heat inside the TC, as well as the nuclear heating.
- The technology limit the helium production to 1 appm for re-welding. The maintenance of the liner has to be carefully planned.

TC nuclear responses

- Local maxima of the nuclear heating and the SS316L helium production are found at the thin layer of inner wall, due to the softening of the neutron spectrum.
- The concrete region with heating > 10⁻⁵ W/cm³ and the 1 cm steel slab with > 0.15 W/cm³ need to be actively cooled.

Impact of footprint size

- Neutron Flux (1/cm²/s) using the beam footprint sizes of 20 × 5 cm² and 10 × 5 cm² are compared.
- Similar distributions are obtained on TC.

Summary

- The softening of the neutron spectrum increases the heating and the helium production at the thin layer of the wall.
- The helium production is a major concern when considering the maintenance of the liner.
- No significant impact on TC neutron flux is found using reduced beam footprint size of 10 × 5 cm² comparing with using footprint 20 × 5 cm².

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