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Institute for Neutron Physics and Reactor Technology (INR)

Neutronics assessment of different quench tank location options in IFMIF-DONES

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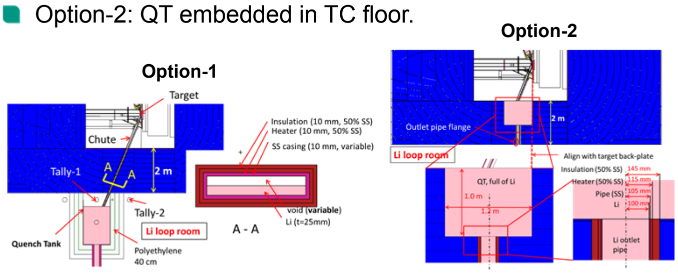
Introduction

- IFMIF-DONES is a **D**EMO **O**riented **NE**utron **S**ource based on the IFMIF engineering design (IFMIF/EVEDA). The Quench Tank (QT) is a caching container for buffering the high-speed Li-flow from the target assembly.
- Due to large size and important hydraulics function of QT, its location has strong impact on the test cell (TC) design. The hands-on maintenance must be allowed for the Li loop room after shutdown.

Model and methodologies

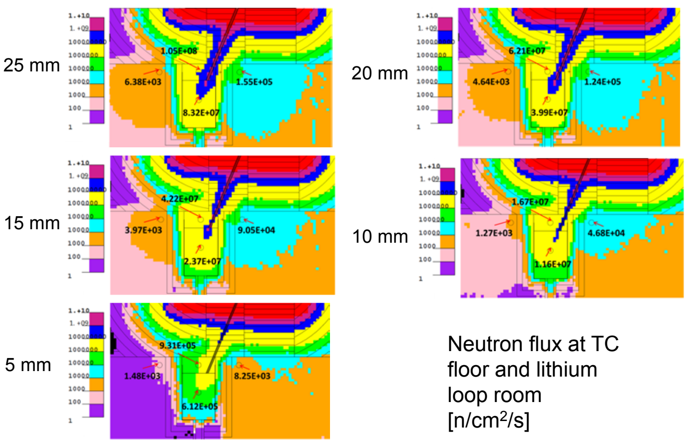
- Option-1: QT located below the TC floor and connecting to the target with a long chute.
- Option-2: QT embedded in TC floor.



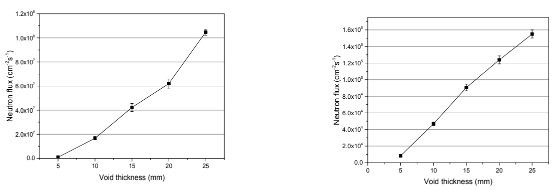
- Transport calculation: McDeLicious-11 and FENDL-3/SLIB4.
- Inventory calculation: FISPACT-07 and EAF-2007
- Shutdown dose rate: Rigorous two-step method code R2Smesh-2.1 developed at KIT.

In-operation Analysis

- Parameter study of the Li-chute void-thickness (Option-1).



Neutron flux at TC floor and lithium loop room [$n/cm^2/s$]

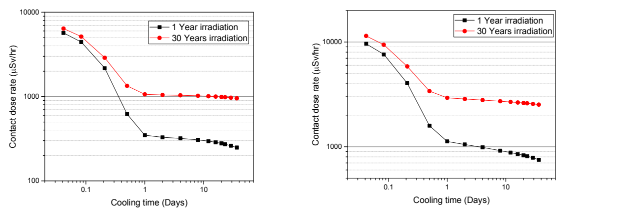


Neutron flux inside QT (Tally-1) Neutron flux outside QT (Tally-2)

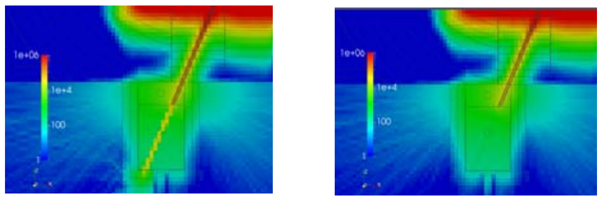
- A quasi-linear relation between void thickness and neutron flux are found inside and outside the QT.
- Decreasing the void thickness from 25 mm to 15 mm reduces ~50% of neutron flux inside QT, which is not so significant to reduce the QT activation.

Inventory and shut-down dose

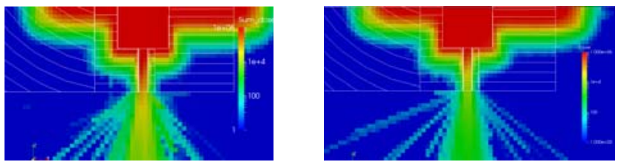
- Inventory calculation of QT (Option-1 with 15 mm void in the chute) and Li outlet pipe flange (Option-2).
- Shutdown dose rate calculation of Option-1 and Option-2. Li is drained out, and gamma source covers 0.5 m of the TC wall.



Contact dose rate of QT in Option-1 (left) and Li outlet flange in Option-2 (right)



Dose rate with (left) and without (right) in-TC components in Option-1



Dose rate with (left) and without (right) in-TC components

- The contact dose rate at critical positions and shutdown dose after one day cooling exceeds the hands-on limits (10 μSv/hr), thus hands-on maintenance is not possible in both QT location options.

Conclusions

- Neutronics analysis have been carried out on IFMIF-DONES to evaluate the neutronics influence of QT in different locations.
- The relation between void thickness in the chute and neutron flux inside and outside the QT is quasi-linear.
- The results indicate that the Li room area is not possible for hands-on maintenance in both QT location options.