

## Activation of the IFMIF Lithium Loop Corrosion Products (P3-J-124)

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The assessment of the activation of steel corrosion products generated in one year of IFMIF lithium loop operation due to the interaction between lithium and Stainless Steel SS-304 has been performed. This paper is mainly focused on the neutron activation and it describes the approach used for and present the results obtained. A preliminary estimate of the accelerator deuteron beam contribute to the activation is also presented.

The study was accomplished through the following phases:

- 1) neutron spectrum calculation in the lithium target via MCNP-4C2 with McEnea neutron source model based on the measurements of neutron emission spectra produced in Li(d,n) reactions for a thick lithium target performed at the "Cyclotron and Radioisotope Center (CYRIC)", Tohoku University, Japan;
- 2) inventories calculations and decay gamma sources production via ANITA-IEAF activation code package; the calculations were performed by considering a lithium mix composition containing lithium impurities and corrosion products referred to 200 wppm of Steel SS-304 corresponding to a corrosion rate of 0.2  $\mu\text{m}/\text{y}$  and a SS-304 wetted surface of 572 m<sup>2</sup>; an irradiation scenario reproducing the integrated (in eleven months of operation) neutron flux responsible for the activation of the circulating corrosion products facing the deuteron beam was considered;
- 3) decay gamma transport analysis for dose rate evaluations via both VITENEA-IEF/SCALENEA-1 and MCNP-4C2 systems for the Longest Pipe of the Lithium loop.

The following conclusions can be drawn by the results analysis:

- dose rates at 50 cm from the Longest Pipe are 198 $\mu\text{Sv}/\text{h}$  and 85 $\mu\text{Sv}/\text{h}$  at 1 day and 1 week from the plant shutdown, respectively
- considering the average 20 mSv/a regulatory limit in Europe for "Radiation Worker" and the four-week period of annual maintenance activities in Li loop, the zone around the piping, exceeding 125 mSv/h, has to be declared "Restricted Access Area"
- the worker radiation protection could be a concern for IFMIF if a good purification system of Li will not continuously run
- specific procedures and worker protection equipments (such as Remote Handling tools) and shielding have to be considered to maintain the Li loop.

Sensitivity analysis has also been performed to evaluate the impact of the choice of different neutron source models, of irradiation scenarios and of corrosion rates/lithium mix composition on the dose rates.

The contribute to the activation of the steel corrosion products due to the deuterons has been estimated to be about a factor 50 higher than the corresponding one due to neutrons. The ANITA-DEUT code, able to manage the deuteron induced transmutation and activation using the activation library based on ACSELAM data, has been used for.