Contribution ID: **152** Type: **Oral**

Progress of Interface Design between Test Cell and Lithium Systems in IFMIF-DONES

Monday 5 June 2017 12:00 (20 minutes)

The Test Cell (TC) in the IFMIF-DONES (International Fusion Material Irradiation Facility- Demo Oriented Neutron Source) facility is the central confinement to envelop the end section of the accelerator, the lithium Target Assembly (TA), and the test modules. The major functions of the TC include: hosting fusion material irradiation experiments in a leak-tight controlled environment, providing sufficient biological shielding to surrounding rooms against the in-TC neutron and gamma irradiation, and allowing media (mainly lithium and helium) and signal/power penetrations between inside and outside of the TC.

The Lithium System (LS) is connected to its in-TC components through an inlet pipe and an outlet pipe, which penetrate the TC confinement. Two main problems are related to these penetrations: compensation of thermal stresses and minimization of neutron streaming.

The latest TC design optimization has suggested including the lithium collecting tank, the so called Quench Tank (QT), inside the TC, to find a trade-off solution among the simultaneous and conflicting issues of lithium flow stability, irradiation shielding, penetrations into TC confinement, tritium production, and remote handling access.

In this paper, the IFMIF-DONES TC design is updated by introducing a TC-Lithium systems Interface Cell (TLIC) below the TC floor to accommodate thermal stress compensation sections of lithium pipes and irradiation shielding materials. In this configuration, the leak tight boundary of the TC is extended to the inner surface of TLIC through the gaps between the lithium inlet/outlet pipes and main body of the TC floor, and the fixing points of the lithium pipes on the TC boundary is arranged on the wall of the TLIC. Inside the TLIC, lithium pipes will be bended in such a way that the thermal stresses are compensated and direct neutron streaming to the LS area is minimized in combination with removable neutron shielding materials. Preliminary thermal mechanical analysis and neutronic simulations are applied to assist the design of the TLIC and the lithium pipe bends.

The TLIC will be equipped with an air-lock door which can be used as remote handling access to compensation pipe sections and shielding materials during the maintenance periods. Corresponding maintenance scenarios of these components are briefly discussed.

Acknowledgments

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No. 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

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Session Classification: M.OA1: Experimental Devices I

Track Classification: Experimental devices