Progress on A-FNS design and R&D
(1) Present status of A-FNS project and progress on design activity

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The A-FNS is planned to acquire initial irradiation data on fusion DEMO reactor materials. Design activities are mainly conducted on the A-FNS accelerator and irradiation test facility. The IFMIF/EVEDA project has also been implemented in collaboration with Europe since 2020 to solve the common issues on lithium target R&D and neutron source design.

Keywords: A-FNS, IFMIF/EVEDA, lithium target, lithium loop, tritium, accelerator, irradiation test facility

1. Introduction

The Fusion Neutron Source A-FNS, which generates high energy neutron by reaction between deuteron and lithium, is planned be constructed in Rokkasho to acquire a variety of irradiation data on fusion DEMO reactor materials. We created conceptual design document of the A-FNS in 2020. We started engineering design activity of A-FNS to solve unique issues for the A-FNS since 2022. The IFMIF/EVEDA project [1,2] has been implemented in collaboration with Europe since 2020 to solve the common issues on lithium target R&D and neutron source design.

2. A-FNS design activity

We have newly designed a variety of unique test modules for the A-FNS, and studied concept of the remote maintenance for the lithium target and test modules. These are horizontally transferred to the lateral access cell from the test cell integrating with the shield plug by remote handling, and we can connect and disconnect those in access cell. For the accelerator design, we have conducted beam simulation and vacuum simulation on High Energy Beam Transport (HEBT) line with dogleg configuration. The placement of the electromagnets was decided so that the beam profile would be within the range of 200 mm in width and 50 mm in length at the Li target. We have established a vacuum design that satisfies the vacuum pressure conditions of e-3 to e-4 Pa on the Li target side and e-5 to e-6 Pa on the HEBT side.

3. IFMIF/EVEDA project

We have conducted tritium migration estimation, dose rate assessment due to activated depositions in Li loop, accident analysis in safety and the redesign of the heat exchanger (HX). For the tritium migration estimation, we estimated tritium migration from the Li loop in operation and during maintenance. We have established the specification of the tritium treatment system. For the dose rate assessment due to activated depositions in Li loop, the activation of the backplate and the dose rate due to the activated erosion/corrosion products were evaluated. For the accident analysis, we have newly developed tritium diffusion code for estimation of dose rate based on the Gaussian Puff model. For the redesign of the HX, we studied the candidate oils that can be used for the HX. Therm-S900 will be applied in IFMIF. Since it is harmful material in Japanese regulation, we have studied alternative oil taking into account the environmental standards. We selected dibenzyl toluene, which is highly versatile and is not subject to monitoring chemicals.

[1] J. Knaster et al Nucl. Fusion 57 (2017) 102016.

[2] P. Cara et al “IFMIF/EVEDA Project: Achievements and Outlooks beyond 2020”, presented at FEC 2021.