IFERC Newsletter

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Status of DEMO R&D Activity

Highlights on Neutron irradiation experiments of BFMs

The objective of the DEMO R&D Task-3 is to characterize the Breeding Functional Materials (BFMs) under neutron irradiation. In the BA Phase I, R&D on advanced tritium breeders and advanced neutron multipliers as BFMs with high stability at high temperatures have been performed.

Due to the situation between Russian Federation and Ukraine, the project plan in INM (Russia) was cancelled and the Implementing Agencies agreed to perform neutron irradiations in two separate facilities, the BR-2 reactor of SCK-CEN in Belgium for neutron irradiation experiments for PIEs (Post Irradiation Experiments) and the WWR-K reactor of INP in Kazakhstan for in-situ tritium release experiments.

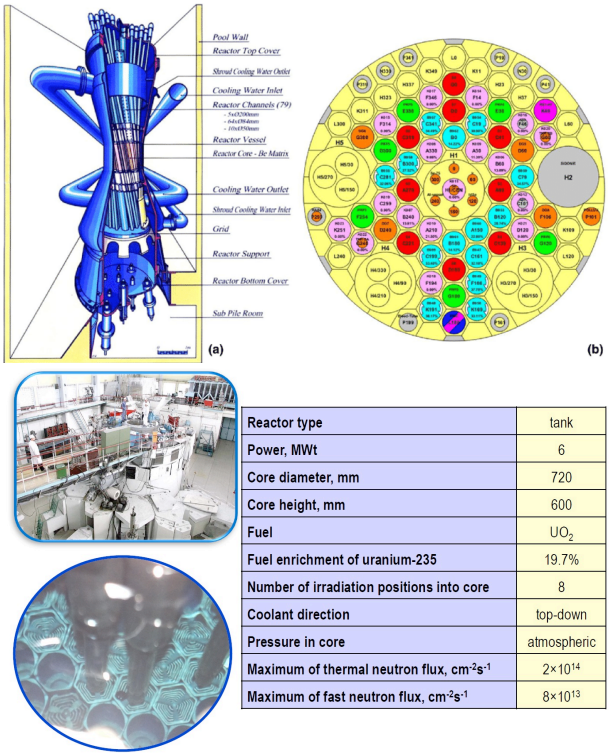
The main objective of the tritium in-situ experiments on the European Ceramic Breeder (EUCB) and Japan Ceramic Breeder (JACB) materials is to collect data on the behavior of the material in terms of neutron interaction, tritium production, tritium retention and release. To reach this objective, several conditions in terms of temperature, composition of the Purge Gas (PG) (i.e. He + x vol% H2), etc. have to be taken into account. The aim is to reach 0.5-1 dpa per reactor cycle in the ceramics, and to lower the dpa/Li-burnup ratio as far as possible to obtain 'ITER-like' conditions by tailoring the neutron spectrum accordingly. The activities are split into 4 subordinate tasks:

- Task A: Development of the irradiation rig design including simulations and calculations to estimate the irradiation temperatures and damage levels of the samples
- Task B: Mock-up testing for the in-situ experiments (incl. QST samples) and the resulting final rig design for the irradiation of EUCB and JACB
- Task C: Technical preparations for the in-situ experiments include the development, adaptation, assemblage of the tritium measurement system, the purge gas loop, and the tritium disposal system
- Task D: Irradiation experiments of EUCB and JACB pebbles with in-situ tritium release measurements

Concerning the neutron irradiation of PIEs in BR2 reactor, the main scope of this activity is the material's qualification for their use in the ITER-TBM. The activity will be implemented via a sequence of phases, where each phase completion should be approved by EU and JA prior to proceed to the next phase.

- Phase 1: Development of design documentation & Safety case study
- Phase 2: Final design, irradiation cost & time plan
- Phase 3: Irradiation
- Phase 4: Preparation for Transportation

Work plans in 2024 are to start the neutron irradiation for in-situ tritium release experiment for JA and EU samples, and to continue the neutron irradiation for PIEs for JA and EU samples.



Reactor type	tank
Power, MWt	6
Core diameter, mm	720
Core height, mm	600
Fuel	UO_2
Fuel enrichment of uranium-235	19.7%
Number of irradiation positions into core	8
Coolant direction	top-down
Pressure in core	atmospheric
Maximum of thermal neutron flux, $cm^{-2}s^{-1}$	2×10^{14}
Maximum of fast neutron flux, $cm^{-2}s^{-1}$	8×10^{13}

Fig-1: BR-2 and WWR-K reactors

(DEMO R&D Task-3 TROs)