Contribution ID: **21** Type: **Oral Presentation**

#3-21 Characterization of the KATANA water activation loop in the JSI TRIGA reactor by reactor pulse operation using neutron detectors

Thursday, June 12, 2025 3:00 PM (20 minutes)

KATANA is a water activation facility located in the Jožef Stefan Institute TRIGA Mark II reactor in Ljubljana, Slovenia. Since its commissioning at the end of 2023, it has completed three experimental campaigns that have contributed to a better understanding of the water activation processes and their modeling, which are important in the context of research in nuclear fusion, in particular for the future operation of the ITER machine. The facility is designed to provide a flexible benchmark-quality environment for the validation of computational tools for the activation of water and corrosion products. It will also support shielding experiments, in particular for ITER-relevant materials, and serve as a stable source of high-energy gamma rays and neutrons. The computational tools developed for ITER cooling loop characterization consist of two primary methods: computational fluid dynamics (CFD) in conjunction with neutronic simulations. These methods are crucial for the accurate modeling of distributed radioactive sources, such as the cooling water in future fusion plants. CFD focuses on detailed modeling of the thermal-hydraulics, while neutronic simulations are used to predict the behavior of neutrons and their interactions. By integrating these two approaches, a more accurate and comprehensive understanding of water activation under different operating conditions can be achieved. Usually, these calculation tools are validated by dose rate measurements at different positions around the radiation source to ensure the accuracy and reliability of the simulations. This approach is holistic, as the measurements combine neutron and flux information, which cannot be separated from each other. In the present study, a novel method was developed to characterize the water activation loop using neutron detectors during operation of the JSI TRIGA reactor in pulse mode. Pulse operation allows the irradiation of a finite amount of water in the inner end of the KATANA water activation loop in a short length of time, typically below 1 s. As the irradiated water circulates through the loop, it emits neutrons along the way; by measurements using neutron detectors around the loop it is possible to track the flow of the volume of activated water and infer information on the flow dynamics in the system. This approach provides valuable information on the KATANA device characteristics and enables increasing the accuracy of experimental data and improving predictive models for future fusion reactors.

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Session Classification: #03 - Fusion Diagnostics and Technology

Track Classification: 03 Fusion Diagnostics and Technology