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#4-186 Gamma and neutron dose rate measurements around the KATANA water activation loop at JSI TRIGA reactor

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Water as a primary coolant will play an important role in the performance of fusion reactors, as it causes an ionising radiation field throughout the facility after its irradiation and activation and requires improved shielding for instrumentation and personnel. To support ITER, the KATANA irradiation facility, which utilises a closed-water activation loop, was successfully licenced, built and commissioned at the end of 2023 at the JSI TRIGA research reactor in Slovenia. The KATANA serves as a well-defined and stable high-energy (6 MeV - 7 MeV) gamma and ∼1 MeV neutron source. Such a high-energy irradiation facility will enable various experiments based on water activation. The ultimate goal of KATANA is to perform benchmark-quality experiments, e.g. validation of fluid activation codes, and to establish itself as a reference facility for the calibration of high-energy γ detectors, which will significantly support the operation of ITER and other future water-cooled fusion reactors.

During the commissioning phase, and with a focus on safety, γ and neutron dose rate measurements were conducted around the KATANA circuit (within the experimental area enclosed by concrete walls) and across the reactor hall to create a comprehensive dose rate map under various operational scenarios. These measurements were executed in three phases, focusing on different radiation sources: (a) background levels from the reactor without activated water, (b) during steady-state reactor operation with activated water, and (c) with activated water in pulse-mode operation. Dose rates, quantified as dose rate equivalents of H*(10)/time, were measured using a certified neutron probe (Berthold LB 6411) and two γ detectors: a pressurized ionization chamber (Fluke Victoreen 451P-DE-SI-RYR) and a scintillator probe (Automess 6150AD-b/H). The peak γ dose rate observed was up to 5 mSv/h at the close vicinity of the main observation part of the circuit (Snail head), with neutron contributions markedly lower, by more than three orders of magnitude. Due to these elevated dose rates, the experimental zone within the concrete walls has been designated as a red zone, subject to stringent access restrictions. Outside these walls, however, dose rates remained below the limit value of 10 μSv/h, indicating no need for additional shielding. Mapping of the dose field has provided crucial insights into the radiological safety of personnel and established guidelines for the optimal placement/arrangement of detectors within high γ and neutron fields for future experiments at the KATANA facility.

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