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FTP/P7-21: Radiological Dose Rate Mapping of D-D/D-T Neutron Generator Facilities

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DD/DT reaction neutron generators are used as sources of 2.5 MeV/14 MeV neutrons in laboratories for various purposes. 14 MeV neutron generators are proposed to be located at several positions in the ITER vessel for calibrating neutron/gamma diagnostic systems. Detailed knowledge of the radiation dose rates around the neutron generators is essential to obtain data on personnel exposures, calibration time, optimizing the number of calibration points with accuracy and radiological protection of the personnel involved with operation of 2.5 MeV and 14 MeV neutron sources. This work describes the studies carried out towards verifying the neutron and gamma dose rates near DD/DT neutron sources and the adequacy of bulk shielding to meet the stipulated dose limits in personnel occupancy areas of a neutron generator lab. Shielding adequacy was verified by experimental measurements at various locations inside and outside the neutron generator hall during different conditions. The experimental measurements were validated by Monte Carlo simulation code FLUKA, taking into account the geometry and structural details of source and the surrounding materials. Ambient neutron and gamma dose rate profiles and dose rate spectra at various locations are presented in this work. Measurements show a good agreement (up to 20% deviation) with FLUKA simulations. This study has served in generating detailed radiological dose rate maps around 2.5 MeV and 14 MeV neutron generators for various source neutron yields and also in benchmarking the Monte Carlo simulation methods adopted for dose rate evaluations and shield design of such facilities. This study has also yielded valuable information on the response of the various radiological monitoring instruments and the recently procured personnel neutron/gamma dosimeters (MGP-make) for use in mixed neutron and gamma fields in the vicinity of D-D (2.5 MeV) and D-T (14 MeV) generator based neutron sources.

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