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Assessment of Shutdown Dose Rates in the ITER Collective Thomson Scattering System and in Equatorial Port Plug 12

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The ITER Collective Thomson Scattering (CTS) system will be the diagnostic responsible for measuring the velocity distribution function of fusion-born alpha particles in the plasma in order to ensure fusion performance and investigate the physics of fast ions [1]. As the CTS diagnostic is integrated in the Equatorial Port Plug 12 (Drawer 3), with direct apertures to the port interspace where maintenance hands-on operation will be carried out, it is essential to assess the shutdown dose rates (SDDR) in these maintenance areas.

In this work, the D1S-UNED3.1.4 Monte-Carlo transport code, based on the implementation of the direct-one-step methodology in MCNP5 v1.60 [2], was used to estimate the dose rate level 12 days (10^6 s) after shutdown in the port interspace. For that purpose, the design of the CTS system was converted from CAD to MCNP and integrated in the toroidal 40-degree neutronics reference model of ITER, containing both the CTS system and the neighboring diagnostics from the adjacent drawers in equatorial port #12.

The results show that the CTS system does not contribute significantly to the SDDR in the area where hands on maintenance is foreseen with dose rates less than 1 μSv/h. This is in agreement with previous estimates, from analyses performed by the ITER Organization, although with the most recent model of the CTS design there is a slight increase of the SDDR values. This increase can be attributed to design changes and improved shielding modelling and/or most importantly, to statistical fluctuations of the D1S simulations. From a neutronics point of view, as the increase in SDDR is in the range of these statistical fluctuations observed in the results, the design is still compliant with the radiation safety ALARA principle aiming at minimizing radiation doses and there is no requirement for further design optimizations.

References

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