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ITR/P1-02: Nuclear Analyses For ITER NB System

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Detailed nuclear analyses for the latest ITER NB system are required to ensure that NB design conforms to the nuclear regulations and licensing. A variety of nuclear analyses was conducted for the NB system including a tokamak building and outside the building by using Monte Carlo code MCNP5.14, activation code ACT-4 and Fusion Evaluated Nuclear Data Library FENDL-2.1. A special "Direct 1-step Monte Carlo" method is adopted for the shutdown dose rate calculation. The NB system and the tokamak building are very complicated, and it is practically impossible to make geometry input data manually. We used the automatic converter code GEOMIT from CAD data to MCNP geometry input data. GEOMIT was improved for these analyses, and the conversion performance was drastically enhanced. Void cells in MCNP input data were generated by subtracting solid cells data from simple rectangular void cells. The CAD data were successfully converted to MCNP geometry input data, and void data were also adequately produced with GEOMIT. The effective dose rates at external zones (non-controlled areas) should be less than 80 microSv/month according to French regulations. Shielding structures are under analysis to reduce the radiation streaming through the openings. We are confirming that the criterion is satisfied for the NB system. The effective dose rate data in the NB cell after shutdown are necessary to check the dose rate during possible rad-works for maintenance. Dose rates for workers must be maintained as low as reasonably achievable, and at locations where hands-on maintenance is performed should be below a target of 100 microSv/h at 12 days after shutdown. We are specifying the adequate zoning and area where hands-on maintenance can be allowed, based on the analysis results. The cask design for transport activated NB components is an important issue, and we are calculating the effective dose rates. The target of the effective dose rate from the activated NB components is less than 25 microSv/h at 30 cm from the outer surface of the iron cask.

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