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P4.229 An optimized code system for activation and shut-down dose rate calculations

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The neutron-induced activation of materials is an important issue for fusion facilities. Photons emitted by the activated material result in a photon field, whose spatial distribution must be taken into account when planning maintenance during shutdown and for decommissioning. One of the approaches to calculate the shut-down dose rate (SDDR) is the rigorous 2-step method (R2S) which is based on the data flow from neutron transport simulations to activation calculations to generate the photon source distribution. This source is used in subsequent photon transport simulations to calculate the dose rate distributions at different times post irradiation.

We present a new implementation of the R2S approach developed at KIT. Compared to the previous version, it provides a more flexible and clear user interface, assumes less simplifications and is written keeping in mind application to large problems thus establishing a more error-proof and performance-optimized workflow. In particular, the new implementation allows non-uniform rectangular superimposed meshes to represent neutron flux and material distributions. It provides a more robust method to extract information from MCNP model and utilizes FISPACT-II for the activation calculations. It allows computer-specific adjustments to FISPACT-II parallel invocation to optimize the use of file systems on cluster computers. To a large extent, standard Linux command line tools are used to handle intermediate data. Dynamic array allocation is applied in the modified MCNP for sampling the decay gamma source. The code with all interfaces are written in modern Fortran in a modular way, which allows subsequent improvements and modifications.

The paper describes in detail the new implementation and reports first results of the code-to-code benchmarking against validated R2S code implementations. Good agreement is obtained for the ITER SDDR computational benchmark. Further benchmarking against experiments is required to fully qualify the new implementation for applications in design analyses of fusion facilities.

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