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Shielding calculations with MCNPX at the European Spallation Source

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The European Spallation Source (ESS) is a collaboration of 17 European partner countries established to project, build and operate the world's most powerful neutron source in Lund, Sweden. The construction of the facility will start in the course of 2014, and ESS is expected to produce the first neutrons in 2019.

Monte Carlo calculations are required to design the appropriate shielding needed to guarantee the radioprotection of the workers and of the public. We will present here the results obtained with the MCNPX radiation transport code for two critical areas of the ESS facility: the front-end building, and the accelerator-to-target section of the 2 GeV proton linear accelerator.

We have modelled the RFQ, the MEBT and the DTL components of the accelerator, and we have calculated the dose contribution to the rooms adjacent the front-end building, as a function of several shielding solutions. We will discuss the results and present the shielding design in these areas, so to allow unrestricted access during the operation of the accelerator.

We have also modelled the accelerator-to-target section of the accelerator, and we have calculated the dose contribution given by the neutron backshine from the spallation target. These results will be discussed, presenting neutron and gamma doses in the accelerator tunnel.

The exposure limits were set according to international standards, the provisions of Swedish laws, and the indication of the Swedish regulatory authorities. Hence, we will present also the fluence-to-dose conversion factors applied in the shielding calculations at ESS and the relative safety factors.

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