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Radiation Protection Assessment of the Emission of a d-t Neutron Generator: Simulations with MCNP Code and Experimental Measurements in Different Operating Conditions

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Abstract : Practical guidelines are provided in this work for the safe use of a portable d-t Thermo Scientific MP-320 neutron generator producing pulsed 14.1 MeV neutron beams. The neutron generator's emission was tested experimentally and reproduced by MCNPX Monte Carlo code. Simulations were particularly accurate, even generator's internal components were reproduced on the basis of ad-hoc collected X-ray radiographic images. Measurement campaigns were conducted under different standard experimental conditions using an LB 6411 neutron detector properly calibrated at three different energies, and comparing simulated and experimental data. In order to estimate the dose to the operator vs. the operating conditions and the energy spectrum, the most appropriate value of the conversion factor between neutron fluence and ambient dose equivalent has been identified, taking into account both direct and scattered components. The results of the simulations show that, in real situations, when there is no information about the neutron spectrum at the point where the dose has to be evaluated, it is possible - and in any case conservative - to convert the measured value of the count rate by means of the conversion factor corresponding to 14 MeV energy. This outcome has a general value when using this type of generator, enabling a more accurate design of experimental activities in different setups. The increasingly widespread use of this type of device for industrial and medical applications makes the results of this work of interest in different situations, especially as a support for the definition of appropriate radiation protection procedures and, in general, for risk analysis.

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